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A SYSTEM OF TREATMENT

In Four Volumes

VOLUME I.

GENERAL MEDICINE AND SURGERY

A SYSTEM OF TREATMENT

IN FOUR VOLUMES

Volume I. **General Medicine and Surgery**

Volume II. **General Medicine and Surgery**

Volume III. **Special Subjects**

Volume IV. **Obstetrics and Gynæcology**

A SYSTEM OF TREATMENT

BY MANY WRITERS

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VOLUME I.

GENERAL MEDICINE AND SURGERY

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PREFACE.

During the last ten years our knowledge of the measures available for the treatment of disease and the relief of symptoms has become more scientific and therefore more definite in its application. Not only have many of our ideas undergone profound modification, but new fields of work, some of great promise, have been discovered. Of these we may instance Vaccine Therapy, X-ray Therapy, Radium Therapy, Ionic Medication and measures dependent on improved methods of observation and diagnosis such as Bronchoscopy. The subject of the treatment of disease consequently has become more specialised and makes greater demands upon all branches of the medical profession than formerly.

The aim of these volumes is to provide the General Practitioner with a series of practical articles, in as concise a form as possible, describing the modern methods of dealing with all diseases and written by those who have had special experience in the subjects with which they deal.

There are many difficulties in preparing such a work as this. Our knowledge is not yet sufficiently exact to permit dogmatic expression in all instances, or to enable us to differentiate sharply between the various forms of disease. It is therefore inevitable that certain articles should overlap, and that there should be legitimate differences of opinion not only in the subject-matter itself but also with regard to the classification adopted. The Editors have always been guided in their final decision by considerations of convenience rather than of strict symmetry. They recognise that their decisions are therefore open to criticism and will gladly welcome suggestions, either for alterations or additions, to be incorporated in future issues.

This "System of Treatment" was commenced rather less than two years ago, and it is hoped that no material addition to our knowledge made during that period has been omitted. The attempt to keep thoroughly abreast of these additions has been rendered rather more difficult than usual by the decision to issue all four volumes simultaneously, and to provide each with an index which is complete for the whole work.

The Editors wish to express their gratitude to a large number of their colleagues who have in one way or another generously come to their assistance. Sir Patrick Manson, Sir Havelock Charles, Dr. St. Clair Thompson, Dr. Risien Russell, Dr. Gordon Holmes, Mr. Richard Lake and Mr. Victor Bonney have advised them with regard to those departments of Medicine and Surgery with which their names are associated. Dr. Nachbar has kindly given his advice and has also revised a number of the manuscripts. Dr. Torrens and Mr. Frankau, respectively Medical and Surgical Registrar at St. George's Hospital, have acted as sub-editors, reading all the manuscripts and assisting in the passage of proofs through the Press.

The Editors are also indebted to Mr. Charles Hewitt for the preparation of the complete index attached to each volume, to Mr. A. L. Clarke for the correction of the references, and to Mr. J. D. Marshall, of Messrs. Bell and Croyden, who is responsible for the correctness of the various prescriptions.

In addition to the many original illustrations a number of others have been kindly lent by different authors and publishers. These are duly acknowledged in the text.

TABLE OF CONTENTS.

GENERAL SUBJECTS.

PAGE
The Principles of Treatment. *Dr. Mitchell Bruce* . . 1
The Management of the Sick Room . . . . . . *Miss McCall Anderson* . . 26
General Hygiene and Care of Infants and Young Children . . . . . *Dr. Eustace Smith* . . . 44
Surgical Technique. . . . *Mr. G. Lenthal Cheatle* . . 71
Shock and Collapse . . . *Mr. Lockhart Mummery* . 93
Tumours . . . . . . *Mr. Cecil Rowntree* . . 106

INFECTIVE DISEASES. (*See also* Tropical Diseases, Vol. III.).

The General Treatment of Infectious Diseases . . *Dr. Foord Caiger and Dr. H. E. Cuff.* . . . 157
Disinfection. . . . . . *Dr. Harold Spitta* . . . 161
Abscess (Acute) . . . *Mr. Maynard Smith* . . 166
„ (Tuberculous) . . *Mr. Maynard Smith* . . 173
Actinomycosis . . . . . *Dr. Maxwell Telling* . . 177
Anthrax . . . . . . *Dr. Harold Spitta* . . . 179
Cellulitis. . . . . . *Mr. Maynard Smith* . . 181
Chicken-Pox . . . . . *Dr. H. A. Des Vœux* . . 185
Diphtheria . . . . . *Dr. Foord Caiger and Dr. H. E. Cuff.* . . . 187
Endocarditis, Infective . . *Dr. T. J. Horder* . . . 203
Erysipelas . . . . . *Mr. Maynard Smith* . . 209
Erythema Nodosum . . . *Dr. Maxwell Telling* . . 212
Gangrene . . . . . . *Mr. Maynard Smith* . . 214
Glanders . . . . . . *Dr. Harold Spitta* . . . 221
Gonorrhœa . . . . . *Mr. Ernest Lane* . . . 223
Inflammation . . . . . *Mr. C. H. S. Frankau* . . 231
Influenza . . . . . . *Dr. H. A. Des Vœux* . . 233
Measles . . . . . . *Dr. E. W. Goodall* . . 243
Meningitis (Tuberculous) . *Dr. T. J. Horder* . . . 248
„ (Purulent) . . *Dr. T. J. Horder* . . . 249
„ (Chronic Basilar). *Dr. Alfred Gossage* . . 253
Mumps . . . . . . *Dr. H. A. Des Vœux* . . 256
Pneumonia . . . . . . *Dr. Hale White* . . . 258
Rabies . . . . . . *Dr. Harold Spitta* . . . 264

INFECTIVE DISEASES—*continued.*

PAGE
Relapsing Fevers . . . *Dr. C. W. Daniels* . . 266
Rheumatic Fever (Acute) . *Dr. Arthur Latham* . . 268
Rheumatism in Childhood . *Dr. Maxwell Telling* . . 276
Rubella . . . . . *Dr. E. W. Goodall* . . 280
Scarlet Fever . . . . *Dr. Foord Caiger and Dr. H. E. Cuff* . . . 281
Septicæmia and Pyæmia . . *Mr. Maynard Smith* . . 295
Sinus and Fistula . . . *Mr. Maynard Smith* . . 299
Smallpox . . . . . *Dr. T. F. Ricketts* . . . 302
Vaccination . . . *Dr. T. F. Ricketts* . . . 311
Soft Chancre . . . . *Mr. Ernest Lane* . . . 315
Syphilis . . . . . *Mr. Ernest Lane* . . . 316
The Clinical Pathology of Syphilis in Relation to Treatment . . . . *Mr. Wansey Bayly* . . 325
Tetanus . . . . . *Dr. Harold Spitta* . . . 329
Tuberculosis (Acute) . . *Dr. Arthur Latham* . . 332
Typhoid Fever. . . . *Lt.-Colonel Reid Roberts.* . 335
Typhus Fever . . . . *Dr. Foord Caiger and Dr. H. E. Cuff.* . . . 365
Ulceration . . . . *Mr. Maynard Smith* . . 368
Whooping Cough . . . *Dr. Walter Carr* . . . 376

CONSTITUTIONAL DISEASES.

Auto-Intoxication . . . *Sir Thomas Oliver.* . . 386
Arthritis Deformans (Rheumatoid Arthritis, Osteo-Arthritis and Spondylitis Deformans) . . . . *Dr. Jones Llewellyn* . . 391
Treatment of Rheumatoid Arthritis by Counter-Irritation of the Spine . . *Dr. P. W. Latham.* . . 405
Diabetes Mellitus . . . *Dr. E. I. Spriggs* . . . 408
„ Insipidus . . . *Dr. E. I. Spriggs* . . . 428
Glénard's Disease (Enteroptosis) . . . . . *Dr. Maxwell Telling* . . 430
The Surgical Treatment of Enteroptosis. . . . *Mr. Lockhart Mummery* . 430
Gout and Gouty Conditions . *Dr. Arthur Luff* . . . 432
Lardaceous Disease . . *Mr. Maynard Smith* . . 462
Marasmus . . . . *Dr. E. I. Spriggs* . . . 463
Obesity . . . . . *Dr. Leonard Williams* . . 468
Scurvy and Infantile Scurvy *Dr. G. A. Sutherland* . . 475
Rickets . . . . . *Dr. Edmund Cautley* . . 478

CONSTITUTIONAL DISEASES—*continued.*

PAGE
Rheumatism (Chronic) . . *Dr. Charles W. Buckley.* . 483
„ (Muscular) . . *Dr. Charles W. Buckley.* . 492

INTOXICATIONS.

Alcoholism . . . . . *Dr. Purves Stewart* . . 495
Arsenical Poisoning . . *Sir Thomas Oliver.* . . 503
Cocainism . . . . . . *Dr. Maurice Craig and Dr. E. D. Macnamara* . . 505
Food Poisoning . . . *Dr. William Henry Willcox* . 506
Lead Poisoning . . . *Sir Thomas Oliver* . . 512
Morphinism . . . . . *Dr. Maurice Craig and Dr. E. D. Macnamara* . . 516
Pellagra . . . . . . *Dr. F. M. Sandwith* . . 521
Phosphorus Poisoning . . *Sir Thomas Oliver* . . 525
Poisons and Antidotes . . *Dr. William Henry Willcox* . 526
Sunstroke . . . . . *Sir Havelock Charles, G.C.V.O.* 536

GENERAL INJURIES.

Burns and Scalds . . . . *Mr. Maynard Smith* . . 540
Contusions and Hæmatoma . *Mr. Maynard Smith* . . 545
Electrical Injuries and Burns *Sir Thomas Oliver.* . . 547
Wounds . . . . . . *Mr. Maynard Smith* . . 550
„ (Gunshot) . . . *Major C. G. Spencer* . . 557

INJURIES AND DISEASES OF BONES.

Fractures. . . . . . *Mr. Philip Turner.* . . 568
The Operative Treatment of Fractures . . . . . *Mr. Arbuthnot Lane* . . 634
Diseases of Bone . . . *Mr. Ivor Back* . . . 694

INJURIES AND DISEASES OF JOINTS.

Dislocations . . . . . *Mr. Francis Jaffrey* . . 713
Wounds of Joints . . . . *Mr. Francis Jaffrey* . . 734
Sprains . . . . . . *Mr. Frank Romer.* . . 737
Surgical Diseases of Joints . *Mr. Gordon Watson* . . 741
Amputations . . . . . *Professor E. H. Taylor* . . 789

INJURIES AND DISEASES OF THE HEAD.

Injuries of the Head . . *Mr. K. W. Monsarrat* . . 873
Infective Lesions of the Scalp and Cranium . . *Mr. Donald Armour* . . 888
Tumours of the Scalp and Cranium . . . . *Mr. Donald Armour* . . 892

INJURIES AND DISEASES OF THE HEAD—*continued.*

PAGE
Infective Lesions of the Brain and its Membranes . *Mr. C. H. S. Frankau* . . 897

INJURIES AND DISEASES OF THE SPINE.

Injuries of the Spine . . *Professor William Thorburn* . 898
Diseases of the Spine . . *Mr. Donald Armour* . . 912
Deformities . . . . *Mr. Robert Jones and Mr. D. McCrae Aitken* . . . 933

CERTAIN DISEASES AND AFFECTIONS OF THE CHEST AND RESPIRATORY SYSTEM.

Asphyxia . . . . . *Professor Arthur Keith* . . 1008
Injuries of the Chest . . *Mr. H. S. Pendlebury* . . 1021
Inflammation of the Ribs and Sternum . . . *Mr. H. S. Pendlebury* . . 1032
New Growths of the Thoracic Wall . . . . . *Mr. H. S. Pendlebury* . . 1034

DISEASES AND AFFECTIONS OF THE BRONCHI.

Asthma . . . . . *Dr. William Henry Willcox* . 1035
Bronchiectasis . . . . *Dr. Frederick W. Price* . . 1043
Bronchitis . . . . *Dr. Arthur Latham* . . 1049

DISEASES AND AFFECTIONS OF THE LUNGS.

Abscess of the Lung . . *Dr. J. J. Perkins* . . . 1059
Surgical Treatment of Abscess of the Lung . . *Mr. H. S. Pendlebury* . . 1059
Atelectasis and Collapse of the Lungs . . . . *Dr. Frank J. Wethered* . . 1063
Broncho-Pneumonia . . . *Dr. J. C. Briscoe* . . . 1066
Chronic Interstitial Pneumonia . . . . . *Dr. Frederick W. Price* . . 1074
Congestion and Œdema of the Lungs . . . . . *Dr. R. A. Young* . . . 1076
Emphysema and its Varieties *Dr. Frank J. Wethered* . . 1082
Gangrene of the Lung . . *Dr. J. J. Perkins* . . . 1090
Hæmothorax . . . . *Dr. J. J. Perkins* . . . 1090
Hydrothorax . . . . *Dr. J. J. Perkins* . . . 1091
Pleurisy and Pleural Effusion (Sero-fibrinous) . . *Dr. Hector Mackenzie* . . 1093
Pleural Effusion (Purulent) *Dr. W. Hale White* . . 1099
The Surgical Treatment of Empyema . . . . *Mr. H. S. Pendlebury* . . 1101

DISEASES AND AFFECTIONS OF THE LUNGS—*continued.* PAGE

THE TREATMENT OF FISTULOUS TRACKS IN EMPYEMA BY THE INJECTION OF BISMUTH AND VASELINE . . . . . *Dr. James Torrens* . . 1110
PNEUMOTHORAX . . . . . *Dr. J. J. Perkins* . . . 1112
PYOPNEUMOTHORAX . . . . *Dr. J. J. Perkins* . . . 1113
SURGICAL TREATMENT OF PYOPNEUMOTHORAX . . . . *Mr. H. S. Pendlebury* . . 1113
PNEUMOKONIOSIS . . . . *Dr. Frederick W. Price* . . 1115
PULMONARY ASPERGILLOSIS . *Dr. Frederick W. Price* . . 1116
PULMONARY TUBERCULOSIS (The Principles of Treatment) . . *Dr. Arthur Latham* . . 1117
PULMONARY TUBERCULOSIS (Sanatorium Treatment) . . . *Dr. David Lawson* . . 1127
PULMONARY TUBERCULOSIS (Treatment by Graduated Labour) . . . . . . *Dr. Marcus Paterson* . . 1159
PULMONARY TUBERCULOSIS (Treatment of by the Induction of Artificial Pneumothorax) . *Dr. S. Vere Pearson and Dr. Claude Lillingston* . . 1164
NEW GROWTHS OF THE LUNG . *Dr. Arthur Latham* . . 1174
SURGICAL TREATMENT OF GROWTHS OF THE LUNG . . *Mr. H. S. Pendlebury* . . 1175

DISEASES AND AFFECTIONS OF THE MEDIASTINUM.

INFLAMMATORY CONDITIONS OF THE MEDIASTINUM . . . . *Dr. Cyril Ogle* . . . 1176
SURGICAL TREATMENT OF INFLAMMATORY CONDITIONS OF THE MEDIASTINUM . . . . *Mr. H. S. Pendlebury* . . 1176
CASEATING TUBERCULOUS GLANDS IN THE MEDIASTINA . *Mr. H. S. Pendlebury* . . 1176
NEW GROWTH IN THE MEDIASTINUM . . . . . . *Dr. Cyril Ogle* . . . 1177

DISEASES AND AFFECTIONS OF THE PERICARDIUM.

PERICARDITIS . . . . . *Dr. Cyril Ogle* . . . 1179
HYDROPERICARDIUM . . . . *Dr. Cyril Ogle* . . . 1185
CHRONIC MEDIASTINO-PERICARDITIS AND ADHERENT PERICARDIUM . . . . . . *Dr. Cyril Ogle* . . . 1186
SURGICAL TREATMENT OF PERICARDITIS . . . . . . *Mr. H. S. Pendlebury* . . 1188

DISEASES AND AFFECTIONS OF THE HEART.

PAGE

ACUTE ENDOCARDITIS . . . *Dr. Arthur Latham* . . 1190
GENERAL TREATMENT OF DISEASES AND AFFECTIONS OF THE HEART . . . . . *Dr. J. Mackenzie* . . . 1194
CONGENITAL AFFECTIONS OF THE HEART . . . . . *Dr. Arthur Latham* . . 1254

DISEASES AND AFFECTIONS OF ARTERIES.

SURGICAL ASPECTS OF HÆMORRHAGE . . . . . *Mr. Gordon Taylor* . . 1255
WOUNDS OF ARTERIES . . *Mr. Gordon Taylor* . . 1278
BLOOD PRESSURE . . . *Dr. Leonard Williams* . . 1281
ARTERIO-SCLEROSIS . . . *Dr. John Hay* . . . 1287
SURGICAL ASPECTS OF ARTERIO-SCLEROSIS . . . . *Mr. Gordon Taylor* . . 1296
AORTIC ANEURYSM (The Medical Treatment of) . . . . *Dr. James Torrens* . . 1297
ANEURYSM (The Surgical Treatment of) . . . . . *Mr. C. H. S. Frankau* . . 1301
EMBOLISM (Excluding Cerebral Embolism) . . . . *Dr. James Torrens.* . . 1306

DISEASES OF VEINS.

VARICOSE VEINS . . . *Sir William H. Bennett, K.C.V.O.* 1309
VARICOCELE . . . . *Sir William H. Bennett, K.C.V.O.* 1323
PHLEBITIS AND THROMBOSIS . *Mr. J. Warrington Haward* . 1328

DISEASES AND AFFECTIONS OF LYMPHATIC GLANDS AND VESSELS.

CERTAIN DISEASES OF THE LYMPHATIC GLANDS . . *Mr. Arthur Connell* . . 1339
HODGKIN'S DISEASE (LYMPHADENOMA) . . . . . . *Professor George R. Murray* . 1341
TUBERCULOUS DISEASE OF THE LYMPHATIC GLANDS . . *Dr. Arthur Latham* . . 1344
THE SURGICAL TREATMENT OF TUBERCULOUS GLANDS . . *Mr. Arthur Connell* . . 1348
NEW GROWTHS OF LYMPHATIC GLANDS . . . . . . *Mr. Arthur Connell* . . 1350
DISEASES AND AFFECTIONS OF THE LYMPHATIC VESSELS . . *Mr. Arthur Connell* . . 1351

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A SYSTEM OF TREATMENT.

GENERAL SUBJECTS.

THE PRINCIPLES OF TREATMENT.

TREATMENT has been employed from time immemorial; and, even when it was directed by men ignorant of pathology and pharmacology or moved by superstition, it proved useful in many instances. The application of experience thus accumulated throughout the ages constituted **empirical treatment.** The only satisfactory reason that could be given by the practitioner for his use of it was that it was successful and answered his purpose. In comparatively recent times light began to break in upon blind empiricism from two sides. First, the wiser members of the profession and of the laity came to see that many so-called cures were wrought by Nature, not by Art: that patients recovered spontaneously without useful help from the practitioner. Secondly, with the advance of the medical sciences, physiological, pathological, clinical and pharmacological reasons (*rationes*) were gradually found for many of the successes of empirical treatment which now could be accounted **rational.** At the same time, more particularly within the last fifty or sixty years, principles of rational treatment were reached independently of empiricism, as a direct result of increased knowledge of anatomy and of physiology; of the causes of disease, the incidence of these on the body, and the reactions of the blood and tissues to them; of pathological anatomy; of the processes of disordered and disabled life observed clinically; and of the actions of medicines and other measures of every kind on the healthy bodies of men and animals.

In the present treatise, whilst empirical treatment will receive the attention that it deserves, *i.e.*, as far as it is successful (for the modes of action of some remedies of unquestionable value remain unaccounted for), our subject is Treatment based upon the facts of the medical sciences just named, and in conformity with them. The principles that guide the practitioner in planning and directing rational treatment are derived from the natural history of disease. By studying this we find that whilst disease, suffering and ultimately death are the result of the actions of unfavourable influences upon the body, this is not the whole truth. The majority of individuals live safely in the midst of these unfavourable influences, and the majority of individuals who do suffer through them recover from illness, although all ultimately perish. The whole truth is that disease, suffering and death occur when physiological provisions for resisting unfavourable influences, for repair, for relief, and for recovery of fitness prove insufficient and fail.

It follows from these considerations that rational treatment must respect the elements of disease that are conservative and recuperative as well as the elements that are pathogenetic, destructive, degenerative, distressing, disturbing and disabling. And it would appear to follow that rational treatment must take the directions of assisting directly and controlling the natural provisions which have been mentioned, particularly when they fail or threaten to fail; of maintaining the functional and anatomical soundness of the mechanisms which represent them; and of copying their actions as far as possible.

These are the broad principles of rational treatment. To appreciate them fully, and to apply them usefully, we must examine analytically a mass of facts on which they are based—ætiological, pathological and clinical. We shall find that whilst these justify the fundamental or general principles just formulated, they also furnish a number of special principles falling under each head. These serve as definite guides to treatment, pointing to the occasion for interference with the natural processes and course of disease, and to the aims or objects of interference, which are accordingly accepted as **indications for treatment.** We shall now proceed to search systematically for indications in the facts connected with the causation of disease, its pathological characters, its clinical phenomena and progress, its complications and terminations, and the period of convalescence.

The means and methods by which **the indications thus determined are to be fulfilled** are a subject entirely different from the principles of treatment, and one which does not call for discussion here. The employment of remedies, the Practice of Medicine and Surgery, cannot be discussed with much profit in general terms applicable to all cases, *i.e.*, apart from the accounts of the treatment of individual diseases to which this article is an introduction. But it will be referred to incidentally by way of illustrating the application of rational principles in the course of our proper inquiry, and will be broadly outlined in a short section at the end.

I. PRINCIPLES OF TREATMENT BASED ON ÆTIOLOGY.

One of the most obvious and elementary principles of treatment is to control the causes of disease. Common-sense tells us that if we could fulfil this indication there would be an end to disease. Complete control of causes would mean prevention. Here we are not concerned with preventive but with remedial treatment, the cure (care—*cura*) of disease that has begun. Yet we shall find that, even when their pathogenetic action has already commenced, the causes of disease may be successfully dealt with therapeutically.

The specific or essential causes of disease are the natural influences of every kind—forces as well as substances, usually extrinsic, that fall upon the body and damage or disorder it. They have been classified under the heads of physical violence, extremes of atmospheric temperatures, impure air, poisons, unwholesome food, parasites, micro-organisms, "nervous" influences, etc. But they are as extensive as man's environment. Substances and actions that are not only not unfavourable but actually necessary to life, such as food and exercise, become pathogenetic when unwisely used. Every influence that acts physiologically on man may cause disease under certain circumstances or in certain individuals.

Acting in opposition to the specific causes of disease is *natural resistance*. This concerns the therapeutist very closely. Essentially a physiological provision, evolved in the struggle for life and health, it manifests itself in different forms, as passive resistance or active opposition on the part of the tissues, the blood and the various organs to specific causes. The most important of these, as far as they concern us in our present inquiry, are: *destruction*, whether intelligently—of such causes as dangerous animals, plants or substances, or automatically—of microbes and their products by phagocytosis and other provisions for immunity; *removal* of threatening or actual causes of disease, usually voluntarily, but also reflexly, by sneezing, cough and vomiting, or automatically by the blood-flow that washes a wound; *flight or avoidance*, deliberately and as seen in negative chemiotaxis; *protection*, as in voluntary and instinctive acts of simple self-defence, and in reflex closure of the glottis and eyelids, and in the passive defence of the integuments; and *reaction*, adaptive or counteractive, a provision by which muscles and nerves in particular, as well as other organs, respond to and control stresses and other kinds of stimulation that might injure the body.

When the specific causes of disease are sufficiently opposed by one or more of these provisions for resistance, health is preserved. When resistance fails to meet a specific cause, such as physical stress, a pathogenetic bacillus or extreme atmospheric temperature, damage, disease or disorder arises. Whilst it is impossible to estimate how often we escape injury and disease, thanks to these provisions for safety and immunity, yet the prevalence of disease and the ultimate certainty of death prove that failure is common, and sooner or later universal. Natural resistance is insufficient. It requires assistance. This is the first fundamental indication for treatment: **(1) to deal with the specific causes of disease directly; and (2) also indirectly by following the different methods of natural resistance, and assisting them.**

(1) The importance of the first part of this great general indication is, and has always been, universally admitted: to strike at the root of disease. The more intimate our acquaintance with the causes of disease, and the closer our attention to them, the more hopeful and successful are public sanitation and medical practice. It is more easy and satisfactory to prevent the tubercle bacillus from reaching the lungs than to treat tuberculosis; more rational to regulate exercise than to attempt to cure dilatation of the heart. Even if the indication cannot always be fulfilled, because we may not be able to identify the specific causes at work, nor to deal with them directly when we do know them, we often can control them through the means and media by which they reach the body, such as personal contact, occupation, food and air.

(2) The second part of this broad principle of treatment—to follow and assist the different methods of natural resistance—requires to be discussed in more detail. We have to discover how assistance comes to be needed: how and in which directions resistance comes to fail. In some instances failure is due to the very severity of the specific cause—a crushing blow, a lightning stroke, excessive cold, a colossal dose of poison; sometimes to its novelty, as in certain outbreaks of infectious diseases in aboriginal populations; sometimes to the frequency of its action, as closely repeated meals produce indigestion. In other instances the mechanism of resistance is at fault. The vomiting centre may fall into a condition of excitement in its reaction to irritant or excessive food, and exhaustion or even death result. Or the parts concerned in the mechanism of resistance may be themselves diseased and fail; cough, for example,

which automatically resists the entrance of foreign particles into the lungs, becomes impossible in some diseases of the larynx. But in the great majority of instances disease arises through some concomitant circumstance or event which either favours the specific cause, or interferes with resistance, or possibly acts in both these directions. Occupation incidentally favours specific causes. Miners are exposed to mechanical stress and brewers' draymen to alcohol. Hot climates and hot weather promote the growth of pathogenetic microbes; and these same specific causes are also greatly assisted in their incidence on man by media of many kinds, including meat and milk and vegetables (in which they first flourish and then are admitted into the stomach), blood-sucking insects, domestic animals and "contacts" of every kind.

On the other hand, resistance is interfered with by countless incidents and conditions of life, and then may prove insufficient to meet ordinary or even insignificant influences, such as moderate muscular exercise, a small meal or a demand for light mental effort. It is in this way that disease mainly originates, and in this direction that the principal indications for prevention and cure of disease are found. A wound of the surface, whether accidental or in the hands of a careless surgeon, directly removes the natural protection provided by the integuments against the entrance of germs. Alcohol so interferes with the thermotoxic mechanism as to contribute to frostbite, gangrene and even death by exposure to cold. In a highly important order of instances with which treatment has always to reckon, resistance has been impaired by remote circumstances in the history of a patient or of his family. Thus damage of the heart, nervous system, or stomach by previous disease or accident acts as a permanent disability or handicap, and renders these organs respectively unprepared for moderate physical stress, a reasonable intellectual effort or an ordinary meal, as the case may be. The wear and tear, physical and psychical, of a strenuous life also may exhaust or break down resistance in different forms. On the other hand, careless, unwise, intemperate, dissipated habits sap a man's self-control, and lay him open to alcoholism and invasion by certain micro-organisms. The insanitary conditions and vicious habits of several generations beget a bodily and a moral constitution too poor, and therefore unprepared, to encounter with success almost any one of the specific causes of disease, whether material, such as hard work, or nervous, such as temptations. Their anatomical and physiological outfit, their physique, becomes more and more imperfect and delicate, and the family and race degenerate. The loss of natural resistance due to these remote contributory circumstances is commonly called predisposition, or a predisposing cause, or a weak or poor constitution. Thus natural resistance in its different forms necessarily varies with age; it may be weakened or may be strengthened from time to time according to circumstances; and it is capable of being influenced by treatment.

It is obvious that many of the conditions, circumstances and events of the average life may contribute to the causation of disease from both sides: by assisting the specific cause and by reducing resistance to it. Climate, occupation, age, either sex with its own peculiar disabilities, periodic or other, afford instances of this complexity of causation. And the causation of disease presents more complexities otherwise than can be followed in this place. How it comes to be necessary to carry this inquiry as far as has been done in a discussion of treatment is that the knowledge and appreciation of the contributory elements of causation afford us a number of occasions and opportunities of interfering indirectly with the specific causes of disease, and also of assisting resistance, and of doing so by ordinary means which are simple, additional to drugs, ready at hand, easily employed and graduated, psychical as well as material, and in many other respects rational and useful.

The individual indications for treatment suggested by a study of the provisions for natural resistance and their failures may now be formulated and illustrated.

(1) **The Specific Causes of Injury and Disease are to be Destroyed.**—This is a rational indication of an elementary character. It is fulfilled to a large extent outside the body by the Medical Officer of Health, both as a matter of general routine, and in the disinfection of patient and room and furniture after an infectious illness. The practitioner scrupulously respects the same principle in the antiseptic treatment of wounds, and in disinfecting sputum, fæces, urine and other discharges in the course of an illness. Within the body he destroys torulæ and other microbes with gastric and intestinal disinfectants. He virtually destroys a poison when he gives a direct chemical antidote —an alkali, for example, in poisoning with acids. He kills intestinal parasites with anthelmintic drugs. He employs every possible means constitutionally to invigorate phagocytosis when the blood is invaded by the organisms of tuberculosis or other infections; and he gives vaccines or serums, such as tuberculin or diphtheria anti-toxin, for their directly or indirectly antidotal action.

(2) **The Specific Causes of Disease are to be Removed.**—Short of destruction, a rational indication for dealing with the specific causes of disease, an indication often more easily fulfilled, is to remove them, and to promote the automatic provisions for the same end. Removal of micro-organisms from the blood is the last phase of phagocytosis, and is completed by the organs of excretion. The surgeon follows this indication before every operation in employing aseptic treatment in detail. Bleeding, unquestionably a provision for washing infectious material from a wound, is not inconsiderately stopped unless in itself dangerous. Emetics remove poisons and unsuitable food from the stomach. Not only irritants, such as unripe fruit, but autotoxic and otherwise offensive substances and collections in the bowels are evacuated by purgatives, which are perhaps the most extensively and usefully employed of all medicinal remedies. Intestinal parasites are removed with vermifuges.. Cholagogues, diuretics, diaphoretics and purgatives, empirically recognised as valuable remedies in illness, whether acute or chronic, no doubt promote elimination from the blood and tissues of noxious materials produced within the body itself, which act as causes of fresh infection, disorder and disease; and hydro-therapeutics are largely based on the same principle.

(3) **The Specific Causes of Disease are to be Avoided, whether Absolutely or Relatively.**—It is obvious that poisons, unsound food, and persons suffering from infectious diseases must be absolutely shunned. It is a matter of far greater importance and difficulty in treatment to lay down rules for the relative or reasonable avoidance of certain specific causes of disease. This involves the personal and social problems of recommending or enforcing, as the case may demand, moderation in eating, drinking, exercise, rest, amusements and pleasures of every kind, as well as in bodily and mental work. In fulfilment of this principle the practitioner has to revise and probably to recast the routine manner of living of his patient, in due relation to age, sex, constitutional soundness or delicacy, individual susceptibility, mental stability, training, social position and the like.

(4) **The Body is to be Protected from Specific Causes of Disease.**—The principle of protection, though far less extensively followed now than in the days of prevalent superstition, is still respected in the routine directions given with respect to the clothing and many other details in the management of children and delicate persons. Certain dressings of wounds and skin diseases have no other object than that of simple protection from contact with infective particles, the patient's hands or his secretions. The individual

organs, such as the eyes, the heart and the brain, in some subjects demand and receive special attention on the same principle.

(5) **Natural Reaction to Specific Causes is to be Assisted, Regulated and Controlled.**—A study of the dynamic causes of damage and disease introduces us to this, one of the most important of ætiological indications. The physical stresses of muscular exercise and effort, whether in laborious occupations, in sport or accidentally, may be so exceptionally severe, or so sudden, as to overcome the adaptive muscular contraction and elastic counteraction by which they are naturally met, particularly in the heart and arteries. The result is strain. Far more commonly physical strain is due to failure of natural resistance to meet quite ordinary stresses. Inherited poverty of physique, the immaturity of childhood, the unsoundness of advanced age, neglect of training, actual damage or disease of the muscular and elastic tissues, *e.g.*, of the walls of the heart and arteries, act as predisposing circumstances. The same class of considerations present themselves in connection with stresses falling on other physiological systems. The nervous system, for example, and indeed all the organs, possess a provision against stress in a reserve of functional capacity ready to meet extraordinary demands upon them. The thermogenetic centre responds to extreme cold. The immunising value of the blood increases as a natural reaction against the presence of organisms within it. But all these provisions fail in certain subjects and circumstances. Strain of the nervous system is less often referable to absolute excess of demand on the brain than to the ordinary pressure of education, occupation or social life on the intellectual and emotional faculties of delicate, unhealthy, badly trained individuals (like so many modern school-children), and of persons already partially disabled by misfortune, worry, and other depressing circumstances or an ill-ordered life. The digestive system, on the other hand, is more often overtaxed by absolute excess of food and frequency of meals; yet there are individuals in whom it is never able to rise to the normal level of physiological activity. And any of the other organs may either be unreasonably strained or fail from incapacity. Many persons suffer from lifelong torpidity of the bowels; others from sluggish action of the liver. Immunity against the common infections, such as measles or scarlet fever, is still insufficient in the majority of persons, and in a small proportion is lost after having been personally acquired.

These are familiar examples of failure of physiological reaction, which obviously is very commonly in need of assistance and control. To adapt the functional capacity of any organ to reasonable demands upon it, or conversely to adapt the amount of work to the functional capacity of an organ, is one of the most frequent as well as difficult duties that the practitioner is expected to undertake in directing treatment. How far, in a patient who is understood to be delicate, are his muscles, brain or other particular organ to be exercised: how far relieved from physiological stress? In the general management of such a case it is necessary to begin with a close investigation into the patient's structural soundness; the circumstances in which he has been reared and trained and still lives; and the capacity—muscular, nervous or otherwise—which he displays, whether sufficient or insufficient, on different occasions. The practitioner is then in a position to attempt at least to fulfil this important indication. He arranges and superintends physical exercises for school-boys. He absolutely forbids unreasonable exertion in all instances, however strong the individual. He definitely limits the exercise of such as he finds relatively disabled or otherwise unfit for average efforts. Whilst discountenancing excessive intellectual work in every pupil, he does not permit those who are intellectually weak or emotionally delicate to be subjected to ordinary pressure at school. In connection with other functions, he appreciates that it is equally rational to forbid excessive indulgence in food; to provide in every instance a specially digestible diet for patients seriously ill; and to provoke increased reaction in the stomach of the convalescent by means of attractive dishes and gastric stimulants and tonics.

These principles may be formulated as follows: (*a*) Absolutely excessive stresses of every kind are to be reduced to reasonable amount. The abuse of athletics is stopped; the hours of labour are shortened; lessons are cut down; extraneous work—political, municipal, philanthropic—is forbidden to the overtaxed man of business; over-indulgence in eating and drinking is repressed. The indication is: *temperance in all things.* (*b*) When the demand for work is reasonable, but reactive capacity is insufficient from some circumstance or other, the indication is to cultivate or recuperate the function by means of graduated exercise, along with proper nutrition and provision for periodical rest and sleep. (*c*) Exercise of the various organs must be apportioned to the age, sex, habits, circumstances and possible disabilities of the individual patient; and an outlook kept for evidences of overwork, which would call a halt. (*d*) Artificial stimulants, such as alcohol, which enable a man to overwork himself, and lead ultimately to exhaustion and degeneration, must be forbidden, unless under strict observation and control.

II. PATHOLOGICAL INDICATIONS.

We have seen that natural resistance to influences unfavourable to health and soundness often fail, even when assisted by treatment based on rational principles. The result is damage and disease. A study of the pathological conditions thus established, as observed in the laboratory (experimentally in part) and post-mortem room, affords material from which fresh indications can be drawn.

The processes of disease prove to be not wholly disabling and destructive. In part they are conservative, constructive and recuperative. While they have mainly to be controlled, like the specific causes of disease, those elements of them which make for recovery will have to be assisted and regulated, as we assist and regulate natural resistance. Indeed, resistance in several of its forms is continued after disease has actually commenced. Although insufficient to prevent the development of the morbid process, phagocytosis and the immunising action of the blood serum do not fail entirely, but may on the contrary develop and increase in power. They are the prominent elements of the conservative factor of inflammation, attacking and destroying, as far as their power extends, micro-organisms and their products. At the same time the constructive factor of inflammation comes into action in the form of **repair**; and repair has also a collateral effect, in some cases, of limiting the spread of micro-organisms by means of adhesions, encapsulation, thrombosis and allied changes. A third factor of inflammation favourable to recovery is removal of the offending causes and their products, directly and indirectly. This is familiar in purulent discharges, in the disappearance of serous pleurisies, and in the elimination of infection by the kidneys in typhoid fever; and even structural changes produced by pathological processes of the kind may be removed by re-absorption, and their functional effects corrected by the great recuperative process of hypertrophy, which compensates for valvular and other grave lesions. With this there is sometimes associated dilatation, which has the effect of meeting disturbances in the volume of the contents of the vascular system, the cavities of hollow viscera, such as the heart, stomach and bladder, and other distensile structures, by virtue of the extensibility and elasticity of their walls. Again, hæmorrhage, which we found to provide a means of resistance to the entrance and action of micro-organisms in wounds, is sometimes a source of spontaneous relief from high blood-pressure—epistaxis, for example, in renal disease, and hæmoptysis in mitral stenosis. It is naturally arrested, when excessive, by spontaneous closure of the breach in the vessel walls, by coagulation, and by fall of the blood-pressure associated with cardio-vascular failure. Still another recuperative factor met with in pathology is anatomical re-adjustment, which is seen in the establishment of collateral circulation, correcting vascular obstruction; in the fresh visceral relations set up within the chest, consequent on repair of pleuritic and pulmonary diseases; and in the development of compensatory curvature of the spine and of some of the so-called "deformities" of the limbs in paralysis.

When these and other conservative and recuperative provisions prevail, the processes of disease are arrested, whether early or late; certain of its effects are removed, and others compensated; and either complete or incomplete recovery is the result. No doubt this occurs in many instances. But in other instances the provisions fail, and disease progresses to permanent damage and consequent functional disability of every degree; to loss of substance—destruction of the affected parts, molecular or *en masse;* and possibly to death. Assistance is necessary in the form of treatment based on pathological knowledge, of which the barest outline has just been given. How urgent is the necessity and how rational the principle of coming to the aid of Nature in the direction indicated by pathology is proved by the success of the modern treatment of wounds which we owe to the genius of Pasteur and Lister.

The broad principles upon which treatment is planned from the side of pathology are to control the destructive factor of the processes of disease, and to assist and copy its conservative and constructive factors. How these ends are to be effected in detail may be learned by discovering and studying *the individual indications* furnished by the failures of the different natural provisions which we have enumerated.

(1) The **conservative** factors of resistance and **inflammation,** phagocytosis and immunity, may be absolutely unable to cope with virulent micro-organisms or other malignant agents, or may be relatively enfeebled by constitutional weakness of the patient, personal or inherited, or by visceral unsoundness. The surgeon appreciates the necessity of extirpating malignant growths; of destroying infection in wounds with antiseptics, or even escharotics; of cleansing foul cavities; of removing diseased glands and other foci of possible invasion. Internally, arsenic, mercury, quinine and salicylic acid are employed on the same principle to destroy specific organisms or their products. At the same time phagocytosis and immunity are to be promoted: both locally, by certain measures, particularly heat, that favour vascular relaxation,

diapedesis and serous effusion; and constitutionally, by means of vaccines or serums, supported by abundant nutrition, perfect ventilation and close attention to the action, of the organs of elimination.

(2) A study of **repair**, the great constructive or reconstructive factor in pathological processes, reveals the conditions necessary to its success, and the manner in which these may be wanting, and healing fail to be secured. Poverty or deficiency of blood, only too common in patients of every class, deprives a diseased organ of an essential necessity to repair; and here, again, the importance is seen of a generous diet, an abundant supply of fresh air and attention to the bowels and kidneys. As the nutrition of every part is under the control of the nervous system, so repair sometimes proves to be arrested or delayed by unfavourable nervous influences, emotional, reflex or peripheral. Unless the indication to remove or control these be fulfilled, they either directly, or it may be indirectly through pain and want of sleep, beget general restlessness and local movement. Now *rest* is of all ordinary conditions the one most favourable to repair: physical rest of the diseased part; general bodily rest in bed, or at least from work; mental quiet and calm; reduction, sometimes to complete intermission where possible, of functional activity of the muscles, secreting glands, organs of sense and the like. An obvious object in treatment directed to healing a wound or a diseased organ is to relieve discomfort of every kind, particularly pain, that interferes with rest. To secure this end we may have to employ general as well as local measures, including anodynes and hypnotics, and at the same time to spare no pains to allay the anxiety of the patient and remove from him all sources of mental disturbance, depressing or exciting as the case may be. Whilst repair has thus to be variously assisted, it has also to be controlled. Structurally it is effected mainly by a process of connective-tissue growth, and this may be excessive, especially when the process is slow and rest insufficient, as in valvular endocarditis, with the result that adhesions, strictures, opacities and visceral indurations are set up, which seriously impair different functions and may even of themselves prove fatal. On the other hand, this very effect may be indicated, viz., to promote adhesion, fibrous encapsulation and thrombosis, in order to secure *limitation* of an infective and destructive process.

(3) None of the conservative and constructive factors of disease more often calls for assistance than **removal of the products** of the struggle between them and the destructive factor—pus, effusions, blood, *débris* of degenerated cells and other tissue—elements that

have perished or have been produced in excess, and the remnants of the micro-organisms, parasites or other foreign materials that represent the defeated invaders. This indication is fulfilled in a summary way by the surgeon's knife and drainage tube, or other means are employed on the same principle: by aspiration of the pleura; by the use of expectorants to clear the respiratory passages, of mild purgatives in typhoid fever and dysentery, of large draughts of water or milk in acute tubal nephritis, of massage and bandaging in gout, rheumatism, etc.; by routine recourse to elimination in acute diseases by means of purgatives, diuretics and diaphoretics; and by wholesome exercise in many chronic complaints. Finally, some of the unfavourable effects of repair in the forms of stricture, fibrosis and vascular obstruction are to be corrected by promoting **anatomical re-adjustments** or by copying these natural provisions. This indication is followed particularly by the surgeon in short-circuiting for pyloric obstruction, in establishing increased communication between the portal and systemic veins for hepatic cirrhosis, and in the many procedures for spinal curvature and talipes.

(4) **Hypertrophy,** a natural process and effect of continued reaction to physical stress, which we have already studied in connection with ætiology, offers two diverse orders of indications. The first of these is *to anticipate it:* to prevent, remove or reduce the damage that evokes it—urethral stricture, mitral obstruction developing in acute rheumatism, high arterial tension in chronic Bright's disease.

In the great majority of instances this radical indication presents itself too late, after the necessity for hypertrophy is established. A second indication then becomes imperative: *to promote and maintain hypertrophy, and restore it if it fail.* But in doing so the former indication is not forgotten. The condition that provoked and continues to demand hypertrophy is still to be controlled as far as possible, and any increase of it prevented: urethral stricture is not allowed to become complete; increase of valvular lesions is prevented by warding off fresh rheumatism; all possible measures are employed to reduce arterial tension in nephritis. Hypertrophy is dependent on an abundant supply of pure blood, wholesome nervous influences, and a definite amount of rest, whether continuous or rhythmically discontinuous, as in the heart. Loss of compensation in valvular disease of the heart illustrates the common causes of failure of this provision—anæmia, coronary disease, poverty, misfortune, laborious occupations, indigestion, intemperance, or fresh disease, particularly of the kidneys. Here, as in most of the indications that we have just discussed, we discover the essential necessity for attention to the primary functions of the body—digestion, assimilation, excretion, regulation of the nervous influences reaching the patient and control of occupation. Treatment of cardiac failure in a hospital consists practically in measures for correction of these unfavourable conditions as far as practicable. At the same time various drugs and non-medicinal methods are employed, which directly and indirectly stimulate the myocardium, including digitalis, baths and delicately controlled exercises.

(5) Unless it be associated with hypertrophy, **dilatation,** familiar more particularly in connection with diseases of the heart, vessels, stomach and bladder, is at the best a provision of temporary and precarious accommodation only. Indeed, it is essentially a result and manifestation of failure, of over-filling or of insufficient emptying and consequent over-distension of a chamber or of vessels, the containing walls of which are saved from rupture or hopeless paralysis by yielding to the increased pressure. Dilatation, therefore, indicates treatment by at least three different measures. First, resistance to discharge is to be removed, for example, by dealing with stricture or reducing peripheral resistance to efflux from the left ventricle. Secondly, the muscular power of the walls of the chamber has to be increased by means of stimulants and food, and hypertrophy established or restored. Thirdly, arrears accumulated in and behind the dilated chamber must be cleared away: visceral congestions and dropsy in cardiac dilatation, with venesection or purgatives; residual urine in urethral stricture with the catheter; the gastric contents in pyloric obstruction by means of lavage. When accompanied by fully established hypertrophy, as it is in most forms of valvular lesion, of which aortic incompetence is the type, dilatation is a genuine provision of permanent accommodation, and calls only for limitation of the distending force, sufficient nutrition of the walls, and maintenance otherwise of the necessary hypertrophy which provides for reaction. Under favourable circumstances, as already discussed, compensation of valvular lesions by dilatation with efficient hypertrophy may last for many years.

(6) In spite of the three natural provisions for its spontaneous arrest, **hæmorrhage** frequently is so severe, sudden or persistent as to endanger life immediately or by slower exhaustion. The lesion of the vessel may be extensive, or of a character or in a situation that prevents sufficient contraction and retraction of its coats, or these may be diseased. Coagulation may not occur in time to be effectual, or it is imperfect from some defect in the blood itself. If the hæmorrhage be profuse, the resulting fall of blood-pressure,

instead of being moderate and promoting arrest of the blood-flow, may be rapidly fatal.

The indications for treatment follow directly from the mechanisms of these provisions and from the nature of their failures. Hæmorrhage is not to be inconsiderately checked; for example, bleeding from the nose in chronic Bright's disease. Indeed, hæmoptysis in mitral stenosis may indicate leeching or venesection, to increase the beneficial effect of it in relieving pulmonary congestion and severe dyspnœa. But far more commonly, and in every instance if the heart threaten to fail seriously, Nature's methods are copied without delay. The bleeding point is closed with the finger, with forceps, with ligature, by plugging, or by inducing vascular contraction with medicinal astringents, such as lead, ergot or supra-renal extract. Coagulation *in situ* is promoted with constringent drugs like perchloride of iron or tannic acid, by extremes of heat and cold, and by calcium given internally. Thirdly, the blood-pressure is reduced by compression or ligature above the seat of hæmorrhage; by securing local and general bodily rest and mental quietude—if necessary, with the help of drugs; by limiting food and withholding stimulants excepting *in extremis;* and, in the case of spontaneous hæmorrhage due to high tension, by such measures as purging, and, if necessary, even abstraction of blood.

III. CLINICAL INDICATIONS—(1) SYMPTOMATIC.

The clinical phenomena of disease in progress under observation provide fresh indications for treatment. It is true that they are mainly the symptoms and signs of pathological processes which we have already examined: of the incidence and actions on the body of specific causes; of the resistance of the body to them; and of the processes of repair and recuperation. In the individual case a diagnosis is reached in terms of the cause and of the pathological condition; and the indications drawn from them are identical with those which we have formulated in the preceding sections.

But beyond these we find certain indications which are purely clinical, that is, which are not suggested by either the cause or the post-mortem results of disease. Clinically we have the advantage of studying disease from another side: we observe the destructive and the conservative factors of it actually at work. We observe not only the physical signs of hepatised lung in acute pneumonia and the pneumococcus in the sputum (which give respectively pathological and ætiological indications), but the dyspnœa associated with them, which furnishes additional indications of a purely clinical order. Further, it is only by clinical observation that we appreciate the functional disturbances and distress, local and general, that form a large part of disease in the living subject, whether with or (as is so common) without appreciable pathological change. Such are pain, paralysis, fever, insomnia, loss of appetite and of digestive power, and the many other disorders of a familiar kind. Finally, in every illness, that is, in every case of disease or disorder under observation, there are events and conditions that are not true symptoms of the pathological process itself, but of some passing or incidental influence that disturbs the patient, such as mental excitement, bodily movement, or incorrect diet, medicine or nursing.

When purely clinical phenomena are studied, it is found that many of them included under the name of the "symptoms and signs of disease" are not really morbid, but manifestations of **automatic provisions for relief** from bodily distress and functional disorder. The most obvious of these provisions is *rest.* This is commonly voluntary, deliberately effected either by muscular movement or by muscular relaxation, in the endeavour to remove or to prevent pain, discomfort or distress of different kinds. In other instances rest is secured by pain automatically. Such is arrest of abdominal respiratory movements in peritonitis, and diminished respiratory movements over the affected half of the chest in pleurisy. Rest not only relieves distress, but, as we saw in connection with pathological indications, it promotes repair and control of hæmorrhage, and variously favours the conservative element in inflammatory and other morbid processes. Obviously it prevents or diminishes exhaustion of body and mind.

In certain other cases natural provisions for relief take the opposite form, muscular *reaction.* The abdominal muscles familiarly harden under the observer's hand in affections of the intra-peritoneal structures. Spasm of the eyelids attends inflammation of the cornea and iris, and the result is protection and relief. In a different class of instances increased muscular reaction affords relief by increased functional activity. Thus the deficient oxygenation of acute bronchitis and pneumonia provoke what is called dyspnœa or difficult breathing, which is essentially a salutary hyperpnœa. *Readjustment,* another automatic method of relief, is best studied in the elements of fever—the high surface-temperature, the dilated cutaneous vessels, the sweating, the quickened breathing, which promote cooling of the body. A particularly important means of relieving a diseased and oppressed organ is *vicarious action.* The heart and lungs mutually assist each other in serious affections of either; and the skin, bowels and kidneys display respectively increased activity when the excretory function of the others threatens to fail. The observer is also impressed by the relief that is afforded to local discomfort by calling into action a sensory tract in nervous connection with the affected part, as when rubbing or pinching is instinctively used to assuage pain or itching.

If these natural provisions for preventing and relieving the distress, functional disorders and debility that characterise illness were perfectly successful, there would be no indication for therapeutic assistance. Unfortunately they are not yet sufficiently evolved, and more often than not they fail. Distress in different forms is an essential feature of disease, too severe and prolonged, as a rule, to be met successfully by mechanisms imperfect in themselves and easily exhausted. Organs like the heart and lungs can rest relatively only. On the other hand, joints stiffen and degenerate and muscles atrophy from want of movement; and most of the bodily movements become depraved when their activity is reduced beyond a moderate length of time, and a vicious circle of disorder then spreads through the body from the part that is set at rest. Muscular reaction, as seen in dyspnœa, temporarily precious as it is, is an exhausting method of relief to a debilitated patient with a diseased heart; high arterial tension, which serves as a reactive provision to promote excretion in renal disease, may produce cerebral hæmorrhage, and always provokes cardiac enlargement, which may end in disaster. Vicarious action, whilst affording immediate help to an organ in distress, involves one or more other organs in possible exhaustion and damage.

It follows that the leading indication to be drawn from purely clinical facts and phenomena, in addition to ætiological and pathological indications, is to relieve distress and to correct disorder. This is to be effected in different ways. We may promote the natural provisions for securing these ends, as is done in moderate fever by dilating the cutaneous vessels and provoking perspiration by means of a hot bath. We nourish and stimulate the mechanisms involved; for example, the heart in acute pneumonia. Or we copy the natural method of relief, as is done when we order cold sponging in high fever, and when we give a purgative to assist failing kidneys. In a large number of instances we employ entirely artificial measures—the many anodynes and sedative means, medicinal and non-medicinal, local and general, which we possess. And we never fail to pay close and continuous attention to the primary functions, particularly digestion, excretion and sleep, which are usually disordered.

Treatment of this order, directed to the relief or removal of distress and disorder manifested in the symptoms of disease, is commonly known as *symptomatic treatment*, which includes *palliative treatment.* Indicated as it is by purely clinical considerations, *i.e.*, not directly dependent on ætiological and pathological indications, it often clashes with treatment founded on these. We meet here with one of the great difficulties in practice. There is a reasonable demand on the part of patients and their friends, and an equally strong desire on the part of the practitioner, to follow the natural indications for relief which we have just considered. Pain, distress of every kind and functional disorder are evil in themselves, and, as we have seen, tend to spread throughout the body, involving one organ after another. They unquestionably interfere with repair of tissue and recuperation of function, and favour the causes of disease that may be still active. It is very unfortunate that treatment of so high an order as this should be peculiarly open to abuse. Palliative treatment is so clearly indicated by suffering, so strongly suggested by sympathy, so readily carried out by the many anodyne remedies at our disposal, so immediately successful, that the temptation to resort to it directly and in every instance, and to it alone, is not easily resisted. There are grave reasons against such indiscriminate recourse to palliative and other kinds of symptomatic treatment. In the first place, it diverts attention from the proper use of symptoms as therapeutical guides which we have already determined—the use of them to reach an ætiological and pathological diagnosis from which indications will be drawn. To treat symptoms directly, without inquiring what they signify, is to look at the surface only of disease. And the mistake that is made is more than a mistake of omission. Purely symptomatic treatment, particularly the routine use of sedative drugs, commonly disturbs the primary functions on which nutrition, repair and recovery are dependent—digestion, assimilation and intestinal and renal action. Further, it disturbs the natural phenomena and course of the disease, including the temperature, the pulse and necessarily pain itself, which are valuable clinical guides, and it thus interrupts and may altogether prevent diagnosis, whilst the relief that it affords may mislead the practitioner into a sense of success and security that is unwarranted and often ends in disaster. In other instances palliative treatment is thoughtlessly directed against the symptoms of automatic resistance, repair and relief: to check the salutary vomiting provoked by an unwholesome meal, the removal of infective and inflammatory products in the moderate diarrhœa of typhoid fever, or the useful cough of acute bronchitis.

From these considerations for and against resort to symptomatic treatment an attempt must be made to reach principles sufficiently definite to be usefully followed in practice. In the first place, whatever other use may have to be made of clinical characters and events, they must always be recognised as manifestations of pathogenetic and pathological processes. These, when diagnosed by correct employment of the symptoms and signs of the disease, will furnish their proper indications, never if possible to be left unfulfilled. Secondly, whilst fully alive to this radical consideration, the practitioner may be compelled by gravity or simple severity of the patient's condition to attend first and immediately to symptomatic indications. Whatever the pathological indication may be, he must not hesitate to relieve such symptoms and states as excruciating pain, collapse and imminent asphyxia or syncope; to avert, if possible, impending death; to preserve life and afford comfort until an operation can be deliberately performed, the action of a drug is developed, or some phase of the disease or of repair has been reached and safely passed. But such purely palliative treatment is to be temporary only; is to be made as simple and as little disturbing to the primary functions as possible; and is not to clash, if it can be so ordered, with the pathological indications which are to be attended to in due course.

Less urgent discomfort, distress and functional derangement, which attend disease in every instance, invariably demand attention in the form of general management, particularly nursing. Whatever the disease may be, the elementary necessities of feeding, elimination, bodily hygiene and sleep should never be overlooked by the practitioner in the treatment of acute disease. And equal care is taken to prevent or remove incidental disturbances of every kind and such of their effects as broken sleep, mental depression, rise of temperature or loss of appetite; and, in the words of Florence Nightingale, to "nurse the room" as well as the patient. In the management of chronic ailments, on the other hand, relief often has to be ordered in the forms of occupation, exercise and amusements. None of these simple clinical indications are to be despised. In attending to the pathological indications for treatment, the practitioner is in some danger of neglecting this elementary indication—the control of the details of the management of his cases; of leaving them to the nurse or even to the patient; or, short of this omission, of giving his directions in an indefinite form.

In other instances symptomatic treatment, particularly palliative treatment, is clearly indicated because it is the only treatment possible. Certain diseases are incurable. Again, there are many cases that cannot be diagnosed, so that ætiological and pathological indications remain undiscovered and unfulfilled. And, as we have seen, many common clinical conditions, like paralysis, dysphagia and intestinal obstruction, are but effects of pathological processes at work, and demand symptomatic treatment independently of these.

Finally, we have to acknowledge that it must be left to the judgment and skill of the practitioner how far the first or the second of these great orders of indications, the ætiological and pathological on the one hand, and the clinical or symptomatic on the other hand, should be given precedence in individual cases. Experience is invaluable in difficulties of the kind—experience not simply in the sense of many past opportunities, but of many such opportunities properly employed.

IV. CLINICAL INDICATIONS—(2) PRESENTED BY THE COURSE OF A DISEASE.

From the commencement of a case of disease, or his introduction to it, the practitioner is guided in his treatment by considerations derived from a knowledge of its natural duration, whether definite, as in acute croupous pneumonia, or indefinite, as in acute bronchitis; of its natural course, whether acute or chronic; of the complications and sequelæ that occasionally occur in it; and of the modes in which it may be known to terminate, whether complete recovery, incomplete recovery (damage), or death. Further, as the case progresses he is provided with abundant clinical material, which indicates to him whether the treatment originally instituted should be continued unchanged, or whether it ought to be modified from time to time in accordance with events and the fresh considerations which they furnish.

For **diseases of acute course**, treatment, whatever its nature in accordance with other indications, must in character be prompt, closely attentive, unremitting, resolute and consistent. On the other hand, in **chronic diseases**, which so often are of indefinite duration, the practitioner can usually take advantage of deliberate inquiry and investigation before and in the course of treatment; of measures that are necessarily slow in their action, such as arsenic and tuberculin; of favourable times and seasons of the year (climatic treatment); of different phases of the illness—quiescent or active—for example, in pulmonary tuberculosis. Acute disease, again, demands support of the bodily strength by means of special diet, alcohol in some cases, and stimulant drugs of immediate action; bodily and mental rest is to be secured, particularly in the form of sleep; and full provision made for nursing and general attention to the patient and sick-room, as described in the next article. When this indication is fulfilled in acute diseases of definite duration, without resort to measures involving interference with the natural course of the illness, which would be unnecessary and might possibly be harmful, the treatment is said to be *expectant.* Chronicity of disease indicates a different character of treatment: carefully balanced nutrition, regulated exercise, occupation, and measures that slowly influence metabolism and the composition of the blood, such as baths, mineral waters, massage, and courses of drugs like iodine, mercury and iron. Whilst in acute disease there is obvious and possibly pressing need to deal with the case, such as a poison or septic infection, or with a grave pathological condition, such as strangulated bowel, and thus arrest the disease at once, or at least relieve urgent distress and secondary disorders and dangers, there is an equally obvious indication in chronic disease to shorten its course and prevent acute developments, as is done by operating for a smouldering appendicitis; to delay its progress, if towards death, as in chronic Bright's disease or arterial sclerosis; to maintain compensations, as in valvular disease of the heart, and quiescence, as in pulmonary tuberculosis; and to prevent recurrences when the course of the disease is discontinuous, as in chronic alcoholism and indigestion. Acute disease further calls for courage and cheerfulness on the part of the practitioner, which will be communicated to the patient, and will comfort, reassure and sustain him. Chronic illness requires the cultivation on the part of both practitioner and patient of the qualities of patience, endurance and hopefulness in the face of slow improvement and occasional failure. In this connection a knowledge of the personal qualities, the individuality, of the patient, is of the first importance.

Of the different **terminations of disease,** there is a plain indication to strive for complete recovery. When this is known to be possible, as in the great majority of cases in routine practice, every effort is directed to secure it. Short of perfect cure, the practitioner is often compelled to be content with limiting the amount of damage and disablement that is left at the end of illness—a slightly incompetent valve as the result of endocarditis; a small area of fibrosis in pulmonary tuberculosis; the sacrifice of a finger or of one kidney. When the termination is known from the first to be necessarily fatal, as in Addison's disease, or when the patient's condition becomes hopeless during its course, the proper indications are to make death as remote as possible; to reduce suffering to a minimum; and *in extremis* to practise euthanasia.

Complications and sequelæ occur with sufficient frequency in certain diseases, of which typhoid fever and pulmonary tuberculosis are familiar instances, to indicate the necessity of anticipating them, preparing for them, attempting to prevent them. Such treatment takes the form of special diet, proper drugs, and even more particularly the closest attention to rest and the other details of nursing and general management. The success of these precautions is illustrated in the rational treatment of acute rheumatism which threatens the heart.

The effect of inattention to the same indication is not infrequently seen; complications and sequelæ are unquestionably traceable in some instances to liberties unwisely given to patients, and the injudicious use of drugs prescribed on symptomatic principles only. When complications or sequelæ arise of sufficient importance to demand separate treatment, their significance must be interpreted as are the clinical characters of the primary disease, and ætiological and pathological indications drawn accordingly. An estimate then has to be made of the relative importance of these secondary indications and the primary. Thus intestinal hæmorrhage in typhoid fever may demand temporary cessation of the feeding and stimulation indicated in the third or fourth weeks of the disease. Only sound judgment, guided by experience and the closest attention, can determine the proper line of treatment under these difficult circumstances.

Convalescence is naturally a slow process, and perhaps the most important indication to be drawn from a study of it is to give it abundance of time. It essentially involves rest, mental and bodily, slowly diminishing in degree, that is, giving place gradually to increasing exercise, if possible with change of scene. During the same period nutrition is more and more generously supplied, with or without a proper allowance of stimulants and tonic medicines; but care is necessary in doing so to prevent derangements of the elementary functions. This caution applies more particularly to convalescence in certain individuals—the aged, the delicate, etc., and after certain diseases in which sequelæ or actual relapses are readily induced, such as acute rheumatism and typhoid fever.

PRACTICE.

It was said in the introduction to this article that, as distinguished from the principles of treatment, practice in the comprehensive sense of the term is a subject that cannot be successfully learned from books. It is in connection with the treatment of individual diseases, as discussed in the present volumes, or as taught in wards or out-patient rooms by physician or surgeon, that the student acquires the art of balancing the different indications which he has found, and of selecting and ordering therapeutical means calculated to fulfil them.

But this essay would be incomplete without a simple outline of the general order of therapeutic procedure. *In every instance this is preceded by a diagnosis*—a complete diagnosis, not a mere naming of the disease. We have seen that there are cases of urgency in which diagnosis of this completeness must not be attempted or may not be practicable. But, consciously or unconsciously, no practitioner treats any case without forming some sort of opinion of its nature and of the condition of the patient, and it is not till then that he considers the methods and means of treatment.

The next step is to make as accurate as possible an estimate of the course that the disease will follow, based on a knowledge of the natural duration and possible terminations of the disease, and on the facts special to the case—its severity, the personal circumstances of the patient, etc. In other words " an opinion is formed " of the case, and of the prospect before both patient and practitioner. From this are derived the indications that have been reviewed under the head of the Clinical Course.

The ætiological, pathological and clinical indications are then determined, singly or in association. Which of them ought first to be fulfilled is next considered, according to their relative urgency and importance; that is, which portion of the treatment is to be first ordered. If treatment can be deliberately employed, provision is first made for that which is necessary in every instance—the general management of the case. Nursing comprises this in great measure—nursing of the patient and of the room; but specific provision also must be made by the practitioner for sleep, occupation, rest, personal and family circumstances, etc. Diet must never be forgotten, nor left to the patient and his friends, nor even to a nurse. In this country it is always necessary to refer to stimulants, and to speak definitely.

Many cases require nothing more in the way of treatment than general management, but this in itself obviously may be considerable and difficult to conduct in acute illness, and still more so in chronic complaints. Expectant treatment of this order consists in making the different provisions already named for the nursing or management of the patient, and watching with scrupulous attention and judgment the natural progress of the illness, undisturbed by meddlesome interference for the sake of "doing something," which often proves to be harmful, or at least misleading diagnostically and therapeutically. A golden rule in treatment is to let well alone.

In this procedure of deliberately planned treatment medicines are considered last in order, for the reason that they are not always necessary. Drugs must not be given inconsiderately, but only to fulfil an indication which cannot be fulfilled by other means. The statement of this therapeutical principle does not imply that drugs are not often—it may be urgently—necessary.

If a diagnosis has not been reached or is incomplete, the correct rule of therapeutic procedure is to be careful to do no harm whilst doing the best possible in pursuance of indefinite indications. It is under these circumstances that harm may more easily be done, since distress—particularly pain—is probably calling for measures of relief, and there is always a temptation to follow the only line of treatment demanded. Guided by the results of faithful investigation, and by development of symptoms and signs of the disease, the practitioner may presently discover some rational indication for interference. Or if he have reason to suspect but cannot prove the existence of a disease of first-rate importance like malaria or syphilis, he is justified in making use of experimental medication, say quinine or arsenic, as a test.

If it be difficult for a young practitioner to institute rational treatment at the commencement of a case, it taxes his intelligence and resource far more to conduct treatment through *the different phases of the illness*. He generally finds that he has parted with the authoritative assistance of his text-books. Even when the case is doing well, fresh indications arise, as we have seen, from simple progress. The question "How long?" is constantly put to him by patients in respect of continuance of medicinal treatment; and this, as well as such problems as those of commencing movement after rest and of ordering more generous diet, must be acknowledged to be often difficult to solve with confidence.

Unless it be to make a moral impression on the patient, particularly to encourage him, change for the sake of change only is to be avoided. Here, again, the rule is to let well alone. Considerable changes are best effected gradually—fluid foods are replaced by semi-solids, and these by the lightest kinds of substantial diet. Exercise is strictly graduated when resumed after rest, and so is mental effort, even of a pleasing kind; doses of drugs are cautiously reduced or increased, according to their use.

When a patient is doing indifferently or badly, the line of treatment must be reconsidered from first to last, beginning with the diagnosis, which may have been wrong; next reviewing the indications, which may have been incorrectly drawn; and finally, questioning the fitness and possibly the active value of the remedies employed, the capacity of the nurse, and the loyalty of the patient and his friends. The usual result will be that fresh indications are furnished and followed; and want of success in the first attempt, or it may even be an actual aggravation of the illness, may suggest of themselves the correct treatment. In this connection it is not to be forgotten, as has been again and again insisted on in previous sections, that, like many other so-called "symptoms" of disease, arrest of improvement or aggravation of an illness often can be traced to something outside the disease itself—particularly to derangements of the primary functions of life and the establishment of vicious circles, disease of one important organ causing disturbances of every other organ, which in turn react unfavourably on the primary lesion. Derangement of digestion, constipation and want of sleep specially demand constant attention on this account.

Finally, it is in practice that we encounter *the individuality of the patient*, and appreciate the necessity to reckon with it. Treatment as practised, in distinction from treatment as discussed theoretically, has to be directed to a patient, not to a disease. The individuality of the patient in its different elements impresses a different character on the illness in each instance. Among these elements are sex, age, occupation, social rank, domestic relations, nationality and race; and beneath all these is the patient's very personality, as revealed by inheritance, rearing, education, work and habits, and by his expression, his bearing and behaviour under the trial of illness, and his response to treatment. Strength or weakness, as the case may be, of constitution and character, courage or heartlessness, sensibility or obstinacy, and other qualities entirely personal, indicate respectively lines of treatment that must be followed, not only in ordering medicine and diet, but also and still more in directing the general management of the patient during an acute illness, or in controlling his manner of living and conduct in chronic disorder and disease.

J. MITCHELL BRUCE.

THE MANAGEMENT OF THE SICK ROOM.

In the present day, when the tending of the sick has become the work of a highly trained body of women, and nursing is seldom performed by the uninstructed, it may seem superfluous to write of the management of the sick room, but even in these days many difficult and dangerous cases must be looked after by kind, though uninstructed friends who are quite ignorant of the simplest rules of nursing, or by partially trained nurses, or by those whose days in hospital are long past, and the doctor may find himself faced by the responsibility of being not only physician or surgeon, but also nursing instructor; so it is hoped that the following notes may be of use to those who are cut off from reliable nursing assistance.

In very many cases there is no choice in the matter of a sick room, but if possible one should be secured that has a south aspect, of a sufficient size to allow the bed to be away from the door, windows and fireplace, and with a dressing-room communicating. Unless the weather is very hot, a small fire is desirable to help ventilation, and the nurse must attend to it carefully and see that it does not blaze unduly or go too low and require to be relighted. Coal is best put on by hand, the nurse wearing a glove, rather than with a shovel or tongs, to avoid the disagreeable grating sound which a shovel makes. A thermometer should hang in the room and an even temperature be maintained. A nurse should avoid all unnecessary noise, such as laying down jugs and basins on an uncovered marble-topped basin stand, or wearing creaking shoes, or starched dresses, and a good nurse will do what is required in the sick room and then keep quiet, as continual movement and fidgetting about a room is very trying for the patient.

The nursing of any case can be done much more easily in a single bedstead than in a double one, and in many cases of illness two small bedsteads add very much to the patient's comfort, one to be used for day and one for night.

If there is a carpet on the floor it is best to rub it over with a damp cloth and not to sweep it, though a carpet-sweeper may be used when the patient is sufficiently convalescent not to mind a little noise.

No definite rules can be given as to the duties of a nurse in a private house. She must be a woman of infinite tact if she is to succeed, and if she possesses that qualification in addition to a thorough knowledge of her work or the power of obeying orders with intelligence and accuracy, she will adapt herself to the requirements of any household and will generally be able to gain the confidence of both the patient and his relatives and fulfil all directions given by the physician or surgeon without difficulty. She will be well advised to leave the room for a few minutes during the visit of the medical man, so that the patient may feel free to speak of the nurse, should he wish to do so; otherwise the patient is apt to feel that the nurse is a gaoler from whom there is no escape, and that no appeal is possible. When an operation is to take place it is best to have the carpet taken up and the floor scrubbed with carbolic soap and all curtains and unnecessary ornaments removed. If the operation is an emergency one and there is little time for preparation, the nurse is wise if she disturbs things in the room as little as possible, covering the carpet with brown paper or newspaper with a clean sheet pinned over them, and doing all necessary dusting with damp dusters, leaving furniture, curtains, etc., undisturbed; or a Vacuum Cleaner may be sent for if there is time.

Preparation of Patient for Operation.—If possible, the patient should have a bath the day before and the site of operation should be shaved and prepared. Each surgeon has his own particular way of preparing a patient, but in most cases the nurse will be required to wash the part with soap and water, then with turpentine or methylated ether, and to apply a compress of 1 in 60 carbolic, or 1 in 4,000 perchloride of mercury; for a child a weaker solution would be used; instead of a compress, dry sterile gauze or cyanide gauze may be used. When the skin is prepared with iodine it is done as follows: the night before the operation the part is shaved and washed with soap and water and covered with sterilised gauze, wool and a bandage. Next day, two hours before the operation, the part is painted over once with iodine (2 per cent.), rectified spirit (98 per cent.), and sterile gauze, wool, and a bandage, again applied; just before the operation the surgeon paints the part over once more (*see* Surgical Technique).

An aperient is generally given early the day before, so that the patient may have a quiet night, and this is followed in the morning by a simple enema. As a rule, no solid food is given for six hours before the operation, but a cup of beef-tea is often allowed three hours before the anæsthetic is given. The patient should be loosely clothed in a flannel gown, with a pair of long stockings, and the nurse should see that he has a hot bottle, if necessary, while waiting for the arrival of the surgeon, as the preparation and nervousness are apt to make him cold and shivery.

Just before the operation the patient should be directed to pass urine, and in abdominal cases a nurse is usually required to pass a catheter if the patient is a female.

A woman's hair should be brushed and dressed in two plaits at each side of her head, and in an operation on the neck the plaits should be pinned round the head and the whole covered with sterile gauze fixed with collodion, or a sterile or carbolic towel can be used. If the patient has any false teeth they should be removed.

In towns **the outfit for an operation** is usually procured from some firm which supplies everything required, such as table, basins, dressings, etc., but in the country a nurse must often depend upon what is already in the house and on her own ingenuity.

A wooden table of suitable height and width may be used for an **operating table** ; it should be thoroughly scrubbed and carbolised, and two blankets folded in four should cover it, and over these are laid the mackintosh, sheet and pillow. Bath towels placed under the seat of operation and round the patient are useful, as they absorb quickly and can be easily renewed if necessary, and a foot bath under the table is convenient for soiled towels and dressings. In cases of curetting, a mackintosh made to drain from the table into a foot bath is a convenience. A new fish-kettle or a large enamel pan or bowl makes a good steriliser, and bedroom jugs, basins, and sponge basins, may be used for lotions and dressings, and pie dishes for instruments. Dishes can be rendered sterile either by boiling or by burning methylated spirit in them and inverting until required, or a bath filled with 1 in 20 carbolic may be used and the basins kept in it until they are required. Plenty of sterile water, both hot and cold, should be in readiness, and if the operation is to take place early in the morning a nurse should boil water at night for the cold sterile water, and leave it closely covered; towels should be boiled and covered, or soaked in 1 in 20 carbolic according to the wishes of the surgeon, and the nurse should have the fish-kettle, or pan, filled with boiling water, to which has been added a teaspoonful of bicarbonate of soda to each pint of water, so that the instruments may be sterilised without delay on the arrival of the surgeon. This should be kept boiling during the operation, so that any instrument may be sterilised if required. Two or three small tables are necessary for the surgeon, his assistant, and the anæsthetist, and a nurse should always have a hypodermic syringe and brandy at hand, in case of collapse, Where hot bottles are not plentiful, shelves from the oven wrapped in a blanket are useful, and should a cradle be required after the operation a box with the ends knocked out makes a sufficiently good substitute, while a roller towel makes an efficient abdominal bandage.

As soon as the operation is over and the patient is comfortably in bed, the nurse should get the room in order as quickly as possible, removing all signs of what has taken place before the patient recovers consciousness.

During the first twenty-four hours after operation unceasing care and watchfulness will be required on the part of the nurse. If vomiting occurs in an abdominal case the nurse should support the abdomen with her hand; this gives relief to the patient and prevents undue strain on the stitches. She must also notice that the bandage keeps in position, and apply extra dressing, and an additional bandage if there is any oozing. In cases of hæmorrhage the nurse must apply pressure and send for the doctor, and if the wound is in a limb the limb should be raised.

If signs of internal hæmorrhage appear, such as restlessness, sighing respiration, quick pulse, pallor, the nurse should at once send for the surgeon, and in the meanwhile keep the patient's head low and raise the foot of the bed.

When a patient has retention of urine after operation a nurse can often overcome it by a little judicious management, by applying hot fomentations to the abdomen, or sponges wrung out of hot water to the vulva in the case of female patients, and sometimes a very slight change in position has the desired effect, such as the placing of a pad under the small of the back. The surgeon will give orders as to whether the patient may have fluids by mouth or whether he is to be kept on rectal salines, but in either case it is usual to wash out the mouth frequently with warm water, and when feeding by mouth is allowed it is often started by giving hot water.

When a nurse is ordered to pass a rectal tube she should use a rubber tube with a rounded end and a hole in the centre. It should be 15 inches long and not too pliable, as it is apt to curl up in the rectum. It should be lubricated and passed into the bowel, the external end being placed in a porringer of water, and the nurse should watch the water carefully for the bubbles caused by the passage of flatus. The tube may be ordered to be passed regularly four or six hourly after an abdominal operation, or it may be left to the nurse to pass it should she consider it necessary. It is left in for periods varying for ten minutes to half an hour.

Preparation of Instruments.—Instruments should be boiled for twenty minutes before operation and the water in the steriliser must be boiling before they are put in. Scalpels should be boiled for two and a-half minutes, or be put in pure carbolic for the same time; if they are kept longer the edges become blunted; they may also be sterilised by being placed in absolute alcohol or methylated spirit for fifteen minutes. When the instruments are sterilised they should be placed in sterile water, saline solution, or 1 in 40 carbolic, according to the wishes of the surgeon. After use they should be thoroughly scrubbed with a sterilised brush in hot water and Hudson's soap powder; all instruments should be opened and all joints and corners carefully gone into, and when put into the steriliser they should also be open. After a clean case they should boil for twenty minutes, but if the case has been a septic one it is safer to boil from forty to sixty minutes. They are then dried with a soft cloth and brushed with a wire brush to remove any rust which may have collected on teeth or hinges. Needles, safety pins, exploring needles, syringes, and cannulas should be placed in methylated spirit before being dried.

Bedmaking.—An iron bedstead with a wire wove mattress and a good flat hair mattress is the best bed for an invalid, and it must be made with the under sheet tucked in perfectly smoothly and firmly, so that no creases will come with the weight of the patient. Over this may be put a mackintosh and drawsheet. If the bed must be made with the patient in it, he must have the upper bedclothes removed and be covered with a blanket. He is then rolled gently on his side and the sheet and drawsheet untucked and rolled up close to his back. The clean sheet is rolled half its width and laid close to the sheet already rolled, and tucked in; the drawsheet is then tucked under the mattress and the other end rolled alongside of the sheet. The patient is turned over on to his other side, the soiled linen is removed, and the clean sheets are tucked tightly and smoothly under the mattress. In cases of fracture, or in any case where the patient must not be turned, the bed can be made from the bottom—the sheet being rolled in the same way, only lengthwise instead of from side to side.

When a patient has to be propped up in bed the pillows should be arranged so as to give plenty of support to the small of the back, and two pillows should be placed lengthwise at each side to support the shoulders; a bolster under the knees wrapped in a sheet and tied at each end to the head of the bed gives much support and prevents the patient from slipping down. A bolster under the knees is also used for patients lying flat after abdominal operations.

Bedsores.—The prevention of bedsores is in the province of the nurse, the treatment of them, when formed, is in the hands of the physician or surgeon, and the nurse must report to him the first indication of a bedsore forming and must not treat it herself. All patients who are confined to bed should have their backs and hips washed at least once a day with plenty of pure soap and warm water; the soap must be carefully washed off, and the parts thoroughly dried, and spirit in some form, such as methylated spirit or eau de Cologne, thoroughly rubbed into the skin, which may then be dusted with starch powder.

In cases of long illness a nurse must keep careful watch for any signs of pressure sores on the shoulders, knees, ankles and heels, and it may be necessary to protect the ankles or heels with wool bandaged round them or to make rings of wool covered with bandage in order to keep bony prominences from coming into contact with the bed.

The bed must be made most carefully, so that the sheets are absolutely smooth, and when a mackintosh is used and it is not wide enough to tuck in at each side of the bed, a piece of calico should be stitched to each side, so that there is no chance of a wrinkle. In some cases a whole water bed must be used or a water pillow or air ring may give much comfort.

Change of position is, next to washing, the most important preventive of bedsores, and a skilful nurse will see that her patient is frequently moved from side to side and kept in the required position by pillows.

In cases of incontinence and consequent irritation of the skin it is generally wise to use lanoline, zinc ointment or olive oil. This must be well rubbed into the skin after it is washed. In old people with fractures a water pillow is essential from the first, and a circular one is best.

In cases of paralysis, unceasing watchfulness is required on the part of the nurse, as the care of weeks may be undone by a few hours of neglect.

Enemata.—In giving enemata the patient is usually placed on his left side with the buttocks close to the edge of the bed and the knees flexed. In some cases it is necessary for him to be on his back. He should have under him a mackintosh covered with a towel or drawsheet, and over him a blanket, the bedclothes being turned down below the knees. The nurse having everything in readiness and the syringe filled and in working order, oils the nozzle and the forefinger of the left hand with which she ascertains the position of the anus, and passes the nozzle below the finger into the rectum.

Soap and Water Enema.—One ounce of pure soft soap to a pint of warm water is the usual proportion, and a pint or more may be ordered—less for children according to their age, 1½ oz. for each year being a fair guide. It is generally given with a Higginson's syringe, to which may be attached a rubber catheter; the temperature of the fluid should not be above 98° F.

Olive Oil Enema.—Four to 6 oz. of olive oil are often ordered and are run into the bowel by inserting a soft catheter attached to a tube and funnel. The apparatus should be warmed by passing it through hot water and the oil should stand in hot water for a few minutes. The catheter is then inserted and the oil slowly passed into the bowel. The patient is instructed not to strain and a pad is placed firmly against the anus to help the patient to retain the oil for half an hour; the buttocks should be raised with a pillow. This is followed by a common enema given in the usual way.

Castor Oil may be given in the same way or mixed with soap and water.

Glycerine is usually given with a small vulcanite and glass syringe; from ½ to 2 drachms of pure glycerine may be ordered, according to the age of the patient.

Turpentine can be given in gruel, cornflour, strained Quaker oats or starch mucilage; the usual proportion is 1 oz. of turpentine to 1 pint. It is injected with a Higginson's syringe with a tube attached; if retained, a rectal tube should be passed, or a common enema may be ordered, as it is not desirable that the turpentine should remain in the bowel for any length of time.

Nutrient Enemata.—These may consist of milk, eggs, beef-juice, etc., peptonised. The fluid should be at a temperature of 100° and it is given with a catheter attached to a tube and funnel by a glass pipette.

The usual amount ordered is 4 oz. every four hours. It should be given very slowly, at the rate of an ounce in five minutes. Patients on rectal feeding may be helped to retain the enemata by raising the buttocks on a pillow or by raising the foot of the bed on blocks, by pressure on the anus, or by a firm pelvic binder. A wash-out enema of plain water or boracic lotion is ordered once in the twenty-four hours; this is given with the catheter tubing and funnel; after a certain amount has been given the funnel is reversed over a pail and the fluid allowed to run out, and this process is continued until the fluid is returned quite clear.

Saline.—One teaspoonful of salt to a pint of water boiled and strained may be ordered to be given by the rectum four-hourly or more frequently in cases of collapse; it is given in the same way as the nutrient enema; or continuous infusion may be ordered, and the nurse must watch carefully to see that the fluid is kept at an even temperature and that it is not running too fast. An apparatus with a spirit lamp and thermometer should be used if possible, so that an even temperature is maintained (*see* article on General Peritonitis).

Nasal Feeding.—An ordinary rubber catheter of small size is used, attached by a short piece of glass tubing to a tube and funnel or to the barrel of a glass syringe. The catheter should not be too soft, as it is apt to curl up at the back of the mouth. A nurse may be called upon to feed a patient in this way, and so she must know how to do it. The fluid is strained and heated to a temperature of 100° and brought to the patient's bedside in a jug standing in hot water. The nurse places the patient on his back, with a towel round him, and gently swabs out the nostrils with moist wool; then having passed the apparatus through warm water, she lubricates the catheter with olive oil, and placing her left hand on the patient's forehead to steady the head, passes the catheter with her right hand up the nostril and into the œsophagus. Having satisfied herself that the tube is in the œsophagus, she pours the fluid into the funnel in a steady stream; if the patient coughs the tube should be pinched to prevent the food being forced back. When the feeding is finished the tube should be withdrawn gently, the tubing being firmly held to prevent food escaping.

If nasal feeding is impossible an œsophageal tube may be used; this is lubricated and passed through the mouth into the œsophagus: the food is prepared and given as in nasal feeding.

When a patient has gastrostomy performed a nurse should have a feed ready for the surgeon to give at the close of the operation. These patients are usually fed four-hourly, and 10 oz. are given. This may consist of any fluid nourishment and should be warmed and strained to prevent blocking of the tube. The patient is fed with a tube and funnel and should be kept slightly turned on the opposite side to prevent the food regurgitating or the escape of gastric juice, which is apt to irritate the skin (*see* article on Gastrostomy).

Poultices may be made of almost any meal that will retain heat and moisture. Linseed is usually used.

To make a poultice, a basin, spatula, poultice board and two plates are required. In hospitals poultices are always made upon tow, which must be pulled out and made flat and even ; in a private house linen or flannel is used. The basin must be made thoroughly hot, and a jug is filled with boiling water in which to keep the spatula till wanted; sufficient boiling water is poured into the basin, according to the size of the poultice required, and the meal is quickly sprinkled into the water till it is of the required consistence ; it is then turned out on to the linen, flannel, or tow, and is spread evenly, to within an inch of the edge of the material, with the spatula, which is dipped into the jug between each stroke ; the edges are then turned over and the poultice folded in two and carried between two hot plates to the bedside of the patient ; it is applied, after testing with the back of the hand in case it should be too hot, covered with jaconet and wool, and fastened with a many-tailed bandage. If the poultice has to be repeated, the bandage should be unfastened, and the patient arranged conveniently, so that the fresh poultice may be applied as rapidly as possible and without undue exposure.

When the poultices are discontinued the skin should be wiped dry with a soft, warm towel, and hot wool should be applied. Poultices, if properly made, should retain their heat from half an hour to four hours, according to their size and thickness ; they may be made from ¼ to ½ inch thick. If a jacket poultice is required for the back and front of the chest it should be made on linen in two pieces and fastened on the shoulder. If a poultice is wanted that will retain its heat for a longer time, and if it is to be applied to a part where weight is of no consequence, a satisfactory poultice can be made by boiling linseed or oatmeal, and putting it into a flannel bag, securing the flaps of the bag with a few stitches.

A Mustard Poultice is made by stirring mustard into a paste and mixing it into a linseed poultice made in the ordinary way, the surface of the poultice being covered with fine washed muslin. When a linseed and mustard poultice is ordered and no directions are given as to proportions, a nurse should apply equal parts of linseed and mustard for an adult, and 1 part mustard to 5 of linseed for a child.

Starch Poultice.—The starch is made in the usual way and is spread upon muslin or linen.

A Pneumonia Jacket is made of grey carded wool between muslin and gauze lightly quilted to keep the wool in position and tied with tapes at one side and across the shoulder. These garments can be worn over a poultice or after it is removed.

Hot Bottles may be of stone, tin or indiarubber; they should be put in flannel bags, and additional precautions are necessary with tin bottles, which are more liable to burn the patient. In cases where the patient is unconscious or paralysed a blanket should be placed between the patient and the hot bottle.

Fomentations and Stupes.—To make a fomentation or stupe two thicknesses of old blanket are required and a wringer and two sticks are desirable.

The wringer can be made of coarse towelling with a broad hem at each end, through which the sticks are passed; if this cannot be had a towel can be used, but with the wringer the fomentation can be made drier. The flannel should be placed on the wringer in a basin and boiling water poured over it and the basin carried to the bedside of the patient. The wringer is twisted by means of the sticks until the flannel is as dry as possible; it is then shaken out to get rid of any steam, and applied, covered with jaconet and wool and kept in position by a bandage or binder. Should a turpentine stupe be ordered, put ½ oz. of turpentine in a jug, add a pint of boiling water, and pour over the fomentation flannel. If opium or belladonna is ordered it can be painted on the skin and an ordinary fomentation applied.

Iodine.—When applying tincture of iodine the part should be washed with soap and water before the iodine is painted on.

Cupping may be done with either glass or rubber cups. When the former are used the edges must be well covered with vaseline, and small pieces of blotting paper are picked up with a needle and dipped in methylated spirit and then into a spirit lamp and while burning dropped into the glass, which is immediately inverted over the part to be cupped. When rubber cups are used they should be soaked in water as hot as the hand can bear, and when thoroughly hot and pliable applied to the skin. To loosen the cups the skin should be depressed with the finger to allow the air in, when the cups will come off quite easily.

Leeches.—Before applying leeches the part should be washed and all the soap carefully removed and the skin well rubbed with a towel. A piece of lint with holes cut in it according to the number of leeches to be applied should be laid over the skin. The leeches should be handled as little as possible, and put each in a test tube which has wool in it, so that the head of the leech is at the top of the tube. The tubes should be inverted over the holes in the lint; if the leeches will not bite a little milk may be put on the skin. The leeches will drop off when replete; if they do not do so it is only necessary to sprinkle them with salt. A leech must not be pulled off. The bites should be covered with a film of wool, a pad of gauze, and a bandage ; and the patient must be carefully watched, as the bleeding is sometimes troublesome and difficult to stop.

Mustard Plasters are made by spreading thickly mixed mustard on brown paper and covering it with muslin, or mustard and flour may be mixed and applied in the same way.

Mustard Leaves should be moistened in tepid water and applied. Should a mustard leaf not be obtainable a good substitute can be made by spreading mustard, made in the usual way, on a piece of new flannel, and then scraping off all the superfluous mustard.

When mustard applications are removed the skin should be carefully wiped with a soft towel and covered with wool.

Blisters.—Before application the part should be washed with soap and water and dried ; the plaster is then applied and kept in place by wool and strapping. It should remain on for from six to ten hours, according to the age of the patient, then be removed and the blister snipped at its lowest part and dressed with boracic ointment. If the blister does not rise a poultice or fomentation may be ordered. When the fluid is used it should be painted on and allowed to dry, and a second or third coat may be added, each drying before another is applied. Before applying the fluid the part to be blistered should be outlined in olive oil to prevent the fluid running down.

Ice-bags should be filled with small pieces of ice and suspended from a cradle or in some other way to prevent any weight on the affected part. A single fold of lint should be placed between the ice-bag and the skin. The bag should be refilled before the ice is all melted.

Ice Compresses require constant changing ; a block of ice should be by the patient's bedside with several pieces of lint on it, and the compress changed every few minutes.

Evaporating Lotion is applied on a single fold of lint, which should not be covered nor allowed to become dry.

Cold Baths, when ordered in cases of high fever, are best given at the bedside of the patient in a portable bath. If no temperature is specified, a nurse would prepare the bath with water at a temperature of 65°, or a tepid bath may be ordered, at a temperature of 90°, and gradually reduced by the addition of ice or cold water. The patient should have his clothing removed and be lowered into the bath in a sheet. If ice or cold water is being added the bath may become too full and the water must be baled out or run off if the bath is provided with a tap. The patient should have his temperature taken frequently in the mouth and should be carefully watched for signs of collapse. A certain amount of shivering is probable when the patient is first put into the water, but this will generally subside after a few minutes. The pulse should be watched and brandy and hot bottles should be in readiness in case they are required. If the patient stands the bath well he may be left in it for about ten minutes. When he is taken out he should be laid in bed on a mackintosh covered with a warm blanket, and should be dried rapidly with warm towels; the blankets and mackintosh are slipped away, clothing is replaced, and he is covered with a sheet and blanket. If there is shivering a warm drink may be given, but except in cases of collapse and persistent shivering there is, as a rule, no necessity for hot bottles or many blankets.

Sponging is more usually ordered in this country than the cold bath; it may be ordered either hot, tepid or cold. The patient should be laid on a blanket, covered with a second one, and bath towels can be tucked round him to catch the water that runs down while he is being sponged. Two basins and two sponges should be used and a thermometer is necessary, so that the water is kept at the required temperature. The face should be sponged first and dried, then the chest, abdomen and back. The sponging may be done by dabbing with the wet sponge, or by stroking movements, always working in the same direction.

A Cold Pack is given by wringing a sheet out of water at a temperature of 60°; the bed is covered with a long mackintosh and blanket and the wet sheet rolled under the patient; it should be folded over between his arms and chest and over each leg; a second sheet should be laid over him, with a blanket over all. After ten minutes this is repeated; the upper sheet is sometimes changed more frequently than the under one if it is undesirable to move the patient much.

Cradling is useful for the reduction of temperature, as it can be done without moving the patient in any way. The bedclothes are removed and two large cradles are placed over the patient and covered with a sheet, which is tucked in at the sides of the bed, but left open at the top and bottom to allow of a free current of air; the feet are covered with a small blanket and the nightdress drawn up. If this does not reduce the temperature, ice-bags may be hung from the cradles.

When using any of these means of reducing temperature the nurse should have hot bottles, brandy and a hypodermic syringe in readiness in case of collapse.

Hot Air Baths.—For a hot air bath the patient must have under him a blanket and over him cradles, preferably of wickerwork, which should extend from neck to feet. These cradles are covered with a mackintosh and five blankets, the nightgown is removed, and a small blanket is tucked round the patient's neck and head. A thermometer should hang inside the cradle at the top, and the temperature should not exceed 140°. The hot air is introduced by an Allan's apparatus at the bottom of the bed, the spout being introduced inside the cradle with the blankets pinned round it. The spout should be protected by a wet bandage, in case the blankets should scorch. Hot or cold water is usually given to the patient to sip, and he may be left for half an hour in the bath, or until he is perspiring freely; he must be watched carefully in case he should become faint. When he has been in the bath for a sufficiently long time the lamp should be extinguished and a warm blanket put next him before the cradles are removed, in case the heated clothes falling on him should burn him; he is then left for a time, and when he has finished perspiring he is quickly sponged with warm water and dried with warm towels, all blankets and mackintoshes are removed and a warm flannel gown is put on.

A Vapour Bath is given in the same way, only a mackintosh should be placed under the patient as well as a blanket, and Allan's apparatus with a boiler or a steam kettle should be used, care being taken that the hot water does not drip from the nozzle on to the patient. The temperature should not rise above 120°.

Hot Pack.—A blanket or sheet is wrung out of water at a temperature of 110° and wrapped round the patient, the bed being covered with a mackintosh and blanket. The patient is then covered with two or three hot blankets, and it is usual to give a warm drink. After half an hour, which is the usual time ordered, the patient is rubbed dry with warm towels and a warm flannel gown is put on and the bedclothes replaced.

In all cases where hot baths or packs are given great care must be taken that the patient does not get a chill.

A Mustard Bath is often ordered for children suffering from collapse after diarrhœa. The mustard should be put in a flannel bag or mixed with warm water and added to the bath. The temperature should be 100° for a young child and should not rise above 105°. One ounce of mustard to four gallons of water is usually ordered.

Continuous Baths are sometimes ordered for extensive burns. Warm boracic is generally used at a temperature of 100°. A thermometer must be kept in the water and a water pillow may be laid in the bottom of the bath and another used as a pillow for the head, supported by webbing across the top of the bath. A mackintosh and blanket should cover the bath and small quantities of hot water must be added and the cooler water removed to keep the bath at the required temperature. The patient must never be left and should be lifted on to the bed when requiring to have the water in the bath changed.

Tent and Steam Kettle.—A tent can be easily arranged with screens surrounding three sides of the bed or cot covered with sheets or blankets. A thermometer should hang inside the tent and the nurse should be careful that the spout of the steam kettle is inside the tent, but at a sufficient distance from the patient to avoid all risk of scalding him.

Vaginal Douches are given with a douche-can placed above the patient; rubber tubing and a glass douche nozzle are attached, or a Higginson's syringe may be used with the same nozzle. Douches are usually ordered to be given twice daily at a temperature of 108° to 110°. For hot douches the temperature ordered is usually 118°, but as a rule a patient will not stand a douche at a higher temperature than 115° the first time. Vaseline boracic ointment may be applied to the vulva and adjoining parts if the patient is sensitive. When perchloride of mercury is ordered for douching a nurse should find out from the physician or surgeon whether he wishes it to be followed by a douche of boracic lotion or sterile water. When a vaginal operation or an abdominal operation in which the vagina may be involved is to be performed, the nurse is usually instructed to give douches twice daily for two or three days before the operation. When a patient has to be prepared for perineorrhaphy the part is shaved, washed with ether soap and then with bin-iodide of mercury lotion, and a compress of bin-iodide of mercury (1 in 10,000) is applied the night before the operation. In the morning a douche is given after the enema, and the part is again cleansed in the same way and a dry sterile pad applied. The catheter is passed just before the operation, the part being cleansed with boracic or bin-iodide swabs and a fresh pad being supplied.

After the operation the patient is kept on her back with the knees fastened together and a pad of wool between them. The catheter will be passed eight-hourly or oftener if necessary for at least the first twenty-four hours after operation, and usually until an aperient is given on the fourth day. Olive oil is sometimes run into the bowel the night before and a dose of castor oil given in the morning.

When there is any vaginal discharge the wound and vagina are sometimes irrigated gently with warm boracic lotion, an ordinary irrigator and nozzle being used. The wound is dressed with boracic powder, sterile gauze wool and a T-bandage.

Catheters, when made of rubber, silver or glass, should be boiled, and gum elastic catheters should be laid in 1 in 20 carbolic for five minutes before use; they are then lifted with sterilised forceps into a vessel containing warm boracic lotion or sterile water.

Before passing a catheter on a female patient the external parts should be cleansed with soap and water and with boracic or bin-iodide swabs or some other disinfectant, and the nurse should be careful to sponge from above downwards, and before passing the catheter she should scrub her hands in the same way as she would do before dressing a wound or assisting at an operation. When there is any vaginal discharge, or after an operation for hæmorrhoids, very special care is necessary to prevent infection being carried to the bladder. A nurse should never under any circumstances attempt to pass a catheter by touch, but should always look to see that the catheter is passed directly into the orifice of the urethra, and if by any chance this is not done and the catheter is passed into the vagina, it must be re-sterilised before it is passed.

After use the catheter should be held under the cold tap and a stream of water allowed to run through it from the eye-end; it is then washed with soap and water, syringed with 1 in 20 carbolic, and, if not gum elastic, boiled before being laid away. Glass catheters when in use can be kept in some antiseptic, all other catheters are best kept dry in an air-tight box or jar.

The Nursing of Typhoid Fever.—When a nurse is called upon to nurse a case of typhoid fever in a private house she is not only responsible for the nursing of the patient, but for the safety of all the other members of the household. The following methods are adopted at St. George's Hospital; a single woven wire bedstead is used with a good hair mattress covered with a long mackintosh, a second mackintosh being placed under the drawsheet. If the patient's bedclothes, mackintoshes or linen become soiled by evacuations they are changed at once. When this has to be done, a covered tank, half filled with 1 in 20 carbolic, is brought to the bedside of the patient and the soiled linen is at once put in it; the linen soaks for not less than six hours, and then is boiled. Before giving a bedpan to a patient 4 oz. of 1 in 20 carbolic acid solution are poured into it, and immediately after use the bedpan is covered and removed; 16 oz. of chlorinated lime solution are added to and well mixed with the contents in the bedpan; the bedpan is then flushed with 1 in 20 carbolic, washed with water, and left with 4 oz. of carbolic acid solution in it. The urine, urinals and other receptacles for urine are treated in the same way, except any portion which is reserved for testing. Vomited or expectorated matters are treated in the same way. Sponges, flannels, or other materials which are used merely for the ordinary washing of patients are disinfected immediately after use and kept in a special receptacle. Tow or wool used for receiving or cleansing away evacuations is at once placed in a covered porringer containing 1 in 20 carbolic acid solution and burnt.

Soil which has to be kept for inspection is put in a covered stool-glass and an equal quantity of carbolic solution is added, the glass when emptied being treated in the same way as the bedpan. Enema syringes are soaked in 1 in 20 carbolic acid solution immediately after use and then cleaned in the usual way.

A basin containing 1 in 4,000 bin-iodide solution with a nail brush is placed at the bedside of the patient and a similar one in the lavatory. After attending to the patient or emptying a bedpan, stool-glass, or urinal, the nurse's hands are thoroughly washed with soap and water and the nails scrubbed, after which the hands are dipped in the solution of bin-iodide and scrubbed with a nail brush. During the continuance of a case of typhoid, the lavatory and its fittings are washed daily with 1 in 20 carbolic acid solution.

All feeding utensils after use are washed by the nurse with the greatest care in scalding water in a bowl kept exclusively for that purpose, the cloths used to wipe them being kept apart and when dirty being treated as infected linen. The soiled water is disinfected by adding an equal amount of chlorinated lime solution and is emptied down the stop well, not down the kitchen sink.

In all infectious cases the rooms should have no carpet or curtains and as little furniture as possible; the floor should be washed with carbolic soap: a carbolic sheet should hang over the door; it must be kept damp, and some old linen can be folded and laid on the floor to catch the drippings.

When the patient has recovered the nurse is generally expected to see to the disinfecting of the room. This will probably be done under the direction of the officer of health for the district, or the sanitary authorities. A nurse should take no responsibility in this matter beyond seeing that the directions given are properly carried out and that everything that has been used for the patient or in the patient's room is disinfected or destroyed. In nursing any case in which infection may be carried the nurse is expected to wash and, if necessary boil, all crockery and cutlery used by the patient.

Sick Room Cookery.—Every nurse should have a knowledge of sick room cookery, and should be able to give instructions as to how food for an invalid should be cooked. The following things are usually made by the nurse herself :—

Arrowroot or Cornflour.—Mix a dessertspoonful into a smooth paste with a little milk, boil the milk, and when boiling add the arrowroot; boil and stir for five minutes.

Gruel.—Half pint of water, one dessertspoonful of oatmeal, salt to taste. Make as arrowroot.

Junket.—Half pint of milk, a few drops of rennet. Warm the milk, add rennet and stand in a cool place.

Barley Water.—Two tablespoonfuls of barley, 2 pints of water. Wash the barley thoroughly and put in a pan with 2 pints of cold water. Boil slowly till reduced to 1 pint, strain and flavour with lemon.

Custard.—One teacupful of milk, the yolk of one egg and sugar. Beat up the egg, add milk and sugar, put the mixture in a jug in a pan of boiling water and stir till thick. It should not boil.

Lemonade.—Three-quarters of a pint of boiling water, one lemon, and sugar. Wipe the lemon and peel it very thinly, put the peel in a jug and squeeze in the lemon juice, add the sugar, pour boiling water over, cover the jug and set aside till cold. Strain.

Albumen Water.—The whites of from four to six eggs are well beaten, and 1 pint of cold boiled water is added and well mixed, or the whites of eggs may be put in a bottle with water and the bottle shaken until the contents are mixed; a pinch of salt is added. Strain.

Peptonised Milk.—Take one tube of Fairchild's peptonising powder, add 5 oz. of tepid water, then add a pint of fresh milk, stir well, stand for ten minutes in water as hot as the hand can bear without discomfort for a minute. At the end of the time, pour the milk into a saucepan, and bring quickly to the boil.

Peptonised Beef-tea.—Half pound of beef, ½ pint of water, 20 gr. of bicarbonate of soda, or as much as will lie on a threepenny piece, and a tablespoonful of pancreatic solution. Shred the beef and put it in a saucepan with the water and soda, let it simmer slowly for an hour at a temperature of 140°. Add the pancreatic solution and let it stand peptonising from one to three hours, then strain and bring to the boil to stop the peptonising process. Stir the beef-tea while it is cooking.

Raw Beef Essence.—The proportions should be: 1 oz. of beef free from fat to one tablespoonful of cold soft water. Shred the beef finely; add a pinch of salt. Stir, and let it stand for three hours.

Strain and press through a fine sieve. It should be taken cold and is best given in a coloured wineglass or with port wine.

Beef Essence.—Two ounces of beef cut into small pieces are put into a covered jar. Stand the jar in a saucepan of simmering water and steam for three hours. Press out the juice and give the patient one teaspoonful at a time. Mutton essence can be made in the same way.

Egg Wine.—One egg, ¼ pint hot water, one teaspoonful of sugar, brandy or sherry. Beat up the egg, add sugar and hot water, strain into a glass; add the wine last.

Beef-tea Custard.—One gill beef-tea, one egg, salt and pepper. Remove the germ from the egg, beat up egg sufficiently to mix well; add beef-tea; butter a cup slightly and pour in mixture. Cover with greased paper and let simmer in a pan of boiling water for from fifteen to twenty minutes.

EDITH McCALL ANDERSON.

GENERAL HYGIENE AND CARE OF INFANTS AND YOUNG CHILDREN.

The aim of all nursery rules and regulations is to further the nutrition and promote the development of the little occupants. These rules are subject from time to time to change or modification as knowledge grows and the laws which regulate physical well-being are more generally understood. The views of one generation may differ widely from those of its predecessor, and the practice of one may be reversed in the next. Thus, the stuffy rooms and grudging baths of our forefathers have given place to the open windows and generous scrubbings of the present day, and there is no doubt that the health of the community has benefited greatly by the change. In some other matters the advance has been less complete. Delicate children are still to be seen shivering in bleak weather with bare legs and knees, and in the matter of diet a prodigal excess of the starchy element in the food is still too often held to be essential to the steady progress of growth and development.

The Nursery.—The best situation and arrangements for a nursery are now well known and approved. It is advisable to choose two rooms communicating by a door-way on an upper floor of the house, but not directly under the roof. Of these the day-room should face, if possible, the south or west, for a sunlit room is not only cheery but healthful; and both should be as light and airy as can be managed. The walls should be distempered or covered with a glazed, washable paper. The flooring should be smooth, with closely fitted planks, and if necessary the interstices between them should be carefully caulked. Linoleum, with a few movable rugs, is to be preferred to a carpet; but if the latter be used it must be merely laid down, not fastened with nails, to allow it to be easily removed and beaten. The boards underneath it must be kept very clean. The room is best warmed with an open fire, which encourages ventilation; but it is not easy by this means, nor, indeed, by any other but hot-water pipes, which are otherwise objectionable, to ensure a uniform temperature over the whole room. The temperature is always lower near the windows, and under the door in winter there is always a cold draught sweeping inwards from the landing outside. In cold weather, therefore, the children in their sedentary games should be kept to the middle of the room, and it is advisable to protect them from the draught as they play on the floor by a rug or thick mat laid down against the door. It is not well to have a high temperature in the nursery when the children are much in movement in their play. In a fair-sized room, indeed, it is not easy by means of an open fire to raise the general temperature in cold weather higher than 55° or 60° F., and in corners distant from the fire it will be considerably lower. But this is a sufficient temperature for children as they play if proper attention has been paid to their clothing. Ventilation from the windows without draught may be effected by a window-board, 8 or 10 inches in height, fitted against the inner side of the lower sash. The draught as it enters through the slightly opened window is then directed upwards to the ceiling. The same ventilating arrangement should be used in the night nursery, and it is advisable in addition to place a screen on the window side of the cot so as to shield the child's face from wandering currents of air. Many children are restless at night and get uncovered in their sleep. It is then important to prevent them from lying exposed and naked. Sleeping suits are to be preferred to night-gowns, but if the latter be used they should be closed at the lower border so as to leave only two openings to allow the feet to pass through. The child then cannot uncover himself higher than the knees. The material should be flannel in the colder weather. Care must be taken that the bedclothes are not too heavy or abundant. It is best to use a light, eider-down quilt to cover the feet, but this need not reach higher than the hips. If the child perspires at night it is important to have the sheets and pillow-cases dried carefully before the fire, for if they are really damp mere exposure to the air of the room is insufficient to dry them.

Very careful attention must be paid to the sanitary arrangements in and near the nurseries. Water-closets must be kept clean and regularly disinfected. All drain-pipes must be properly ventilated, and if, as often happens, there is a housemaid's sink near the nursery door, it must not be used for the disposal of bedroom slops, and care must be taken that it is regularly flushed and cleansed. Soiled linen must be removed from the nurseries as quickly as possible; all spoons, jugs, cups, etc., must be kept scrupulously clean; and the keeping of milk or liquid food of any kind in the living or sleeping rooms is to be strictly forbidden.

Care of the Digestion.—In promoting the healthy nutrition of a young child, attention to the state of his digestion is a matter of the utmost importance. In order that his progress may be normal and uninterrupted, a continued and sufficient inflow of properly digested nutriment is indispensable, and this can only go on without a break so long as the gastric activity remains unimpaired. It must be remembered that in the young subject the most hard-worked and consequently the most vulnerable part of his frame is the alimentary canal. Upon this is thrown a burden of work which is far greater than that which is imposed upon similar organs in his elders. An adult has merely to provide sufficient material to meet the waste of his tissues from day to day: the young child in addition is called upon to satisfy the urgent demands of growth and development. Any interference, then, with the ordinary course of nutrition in the young subject is a mishap which it is important to avoid. We must remember that a child readily parts with his heat and is very liable to chills, and that a catarrh, however induced, and however feebly it may affect other organs of the body, rarely spares the stomach and often expends its whole energy upon the alimentary canal. It is then an important duty in the management of the young to see that they are protected from chills of all kinds; especially that the daily washing bath is briskly carried out, that the feet are kept warm, and that the body is adequately clothed. Attempts to "harden" the child must be resolutely opposed. The strange belief is still held by some that if a child be made to "rough it," *i.e.*, if he be habitually bathed in cold water, prevented from warming himself by the fire in winter, and forced to go about in all weathers insufficiently dressed, he thereby becomes impervious to chills and is made healthy and strong! The best that can be said for the "hardening system" is that some children pass through it and live. These survivors are the naturally sturdy subjects whose strong vitality even such treatment as this cannot seriously impair. Many children, however, and these not always the obviously impressionable and frail, if exposed to this treatment, either sink under an attack of bronchitis or pneumonia or other similar illness, or remain pallid and ailing, subject to repeated catarrhs, and a source of continual anxiety. It is impossible to harden a child by exposure, but it is easy enough by such means to make him anæmic and weak, with a lessened power of resisting injurious influences and a smaller capacity for recovery when attacked by illness. It is in the interests of the less sturdy subjects that all nursery arrangements ought to be framed. These arrangements may be modified, if thought desirable, in the case of the very strong children who are not harmed by rougher methods, but modification should be the exception and not the rule. Still, even in apparently strong and healthy subjects, modifications must not be carried too far. Many a child who was born naturally vigorous has through ignorance or carelessness or blind obedience to a mistaken ideal been so chilled and enfeebled immediately after birth as to require very exceptional care and attention for years afterwards. Most of the troubles which arise in the course of hand-feeding in infancy are the consequence of gastric catarrhs and digestive difficulties created by cold feet and insufficient appreciation of the needs and susceptibilities of a young infant during his first month of extra-uterine life. So, again, an older child—one naturally strong—may have his resisting power temporarily reduced by illness. Such a subject requires special care during and for some time after convalescence, for if neglected or treated in the rough-and-ready ways which he had previously been able to bear without injury, he is likely to become a frequent sufferer from gastric and other forms of catarrh. Many a child has owed a long period of ill-health and general weakness to this want of special attention at a time when he was peculiarly vulnerable and open to danger.

The Bath.—The washing-bath should be hot and carried out quickly. A good temperature is 95° to 100° F., and the time occupied should be not more than three minutes. Even this time is too long for some very susceptible children. These weakly ones are best washed by seating them in a bath of hot soap-suds (100° F.) and sponging them quickly with the soapy lather. The child as he steps out, when the short process is over, is wrapped in a large warm bath-towel, dried quickly without exposure, and put at once into his bed. He must not be allowed to run about the nursery in his night-dress or sit at the table with naked feet to take his supper. After a short, hot bath the child leaves the water with his cutaneous vessels full of blood, as in the reaction after a cold plunge. This effect may be aided by emptying over the child as he sits in the bath a small basinful of water of the temperature of 75° F., but the douche must be given by a second person, so that there may be no pause between the last squeeze of the hot sponge and the dash of cold. Whenever cold or cooled water is used as a part of a child's washing-bath it should be applied rapidly and only after a thorough bathing with hot water. The cold sponging sometimes advocated, a process which occupies at least a minute, probably longer, is only suited to sturdy subjects, and if used to a delicate or susceptible child can rarely be anything but hurtful. It must be remembered that the touch of cold water comes as a shock; that the shock is the greater for being prolonged, and that it can only be of service when it is in complete harmony with the capacity for healthy reaction shown by the patient. After the washing is finished the child must not be allowed to play in the water or sit wet and evaporating, but must be removed at once, wrapped from head to foot in a large warm towel and carefully dried. Small children are most conveniently bathed in the nursery with windows and doors closed. In cold weather the bath may be placed on the rug before the fire, but in the summer when there is no fire in the grate the bath should be placed elsewhere and out of reach of the down-draught from the cold chimney, I have known unfortunate results to follow neglect of this simple precaution. The soap used should not be strong and irritating. A good cheap soap for children is the ordinary curd soap, but for exceptionally sensitive skins the Vinolia bath-soap may be used. The ordinary hot-bath in cold weather should be given at bed-time, as less dressing is required when it is over. But if the douche-bath above described be made use of, it is best given in the morning directly the child leaves his cot, as an energetic response is thereby promoted. Another means of assisting reaction, and in a delicate subject none of these should be neglected, is to make the child eat a biscuit or small piece of bread-and-butter shortly before entering the bath, for a completely empty stomach may make reaction difficult or doubtful. After the bath it is advisable to dust the folds of skin, such as the arm-pits and groins, with an antiseptic dusting power. While attending to the cleanliness of the body generally it is important not to overlook special regions and organs. The head should be washed once a week. In the case of an infant this may be done in the bath, but with older children, especially the weakly ones, it is advisable to make this a separate operation, as the process is a somewhat lengthy one. It is best carried out some afternoon or evening while the child is still dressed in his day clothes. It is important to wash the soap carefully out of the hair and to see that the head is thoroughly dried and brushed. The ears must not be neglected. The skin between the ears and the head should be dried with care and afterwards dusted with the antiseptic dusting powder, for inattention to this matter is a fruitful cause of eczema. The meatus too should be kept free from soap, and if necessary may be syringed every few days with warm water after the head is washed in the evening. After an evacuation the nates should be well sponged and dried, and it is important to attend to the cleanliness of the genitals. In little girls the vulva should be cautiously sponged, for a vulvo-vaginitis is easily provoked in some children and is encouraged by want of cleanliness. In boys it is advisable to draw back the prepuce and carefully wash away any secretion which may have collected beneath it. If it be impossible to retract the skin on account of a too narrow opening, the latter should be dilated by the surgeon and any adhesions broken down. Unless the prepuce be very long as well as narrow the operation for circumcision will be unnecessary.

The mouth and teeth must receive due attention. It is advisable to swab out the mouth of an infant after his bottle with a soft rag or large, soft brush, moistened with boiled water to prevent accumulation of curd round the gums and early teeth. By this means thrush can often be prevented. Carious teeth, too, must be stopped or removed, since they encourage the retention of infectious and other germs which may be a cause of danger or discomfort.

The nose is not to be neglected. Children are very subject to catarrhs of the nasal passages and naso-pharynx. In these attacks there is much swelling of the mucous membrane, and the consequent interference with the entrance of air begets a habit of mouth breathing which it is of great importance to avoid. There is also much secretion of acrid mucus, which sets up considerable irritation and, in addition to other evils, encourages the growth of adenoid tissue from which young people are so liable to suffer. It is, therefore, desirable to lose no time in training them to expel secretion from the nose. An infant, when sufficiently advanced to understand what is expected of him, should be taught to blow through his nose into a linen rag, and older children should be practised in the use of the handkerchief, and be made regularly to clear their noses completely at night before they lie down to sleep. It is of the greatest importance to remember that the nose is primarily an air passage, and is to be used as such. The method of breathing, therefore, should always be attended to, and from an early age a child should be taught to breathe through the nose, not the mouth. When respiration is entirely buccal, the nasal recesses are imperfectly ventilated and inadequately cleared, so that they become the resort of unwelcome organisms, which irritate the mucous membrane and further the overgrowth of adenoid tissue. Moreover, as Mr. Arbuthnot Lane has shown, the disuse in early life of the nasal passages in respiration retards or prevents the due development of the jaws, the cheek bones, and the cavity of the naso-pharynx, so that the nose is thin and the palate high, the cheeks are flat, and the naso-pharynx is narrowed and often blocked more or less completely with the adenoid overgrowth.

Again, in the act of breathing, it is important to train the child not only to make proper use of the nasal channels, but also to draw in a sufficient amount of air to distend the lungs completely. This full expansion is essential to the healthy development of the chest wall. Lungs which are imperfectly filled at the end of the inspiratory act become collapsed at the points where the external atmospheric pressure is felt most acutely; the supra-clavicular hollows are deepened and there is marked infra-mammary depression, while in many cases the ensiform cartilage is forced inwards so as to form a little pit at the epigastrium. Such children, if left untrained, too often grow up into adults whose build shows every sign of a poor physique; the chest is long and flat, with depressed ribs; the breastbone, instead of sloping normally forward, is nearly vertical; there are hollows above and below the collar bones; the shoulders are rounded, and the lower angles of the shoulder-blades project. All this may be avoided by proper training while the child is young. Both morning and evening the child should be made to stand with his shoulders well back and his hands on his hips, and take twelve deep inspirations, so as to fill his lungs completely with air. In doing so he must shut his mouth firmly and draw in the air through his nose. These exercises are not to be hurried over, but must be carried out slowly and deliberately, with a definite pause between each successive inspiratory act. It is important in these cases to examine the spine, for if there be any sign of lateral curvature, the breathing exercises must be carried out while the child lies on his back on a hard mattress with his head low.

Dress.—The clothing of young children should always be carefully adapted to their needs. Some require warmer clothing than others, but in all the chest and abdomen should be well protected, especially the latter, as it is there that the most susceptible organs are seated. It is well to regard the flannel bandage as a necessary part of the dress, and to insist upon woollen under-clothing. Even in hot weather light woollen combinations should be worn, in order that the child may not suffer from the sudden drop in temperature which so often occurs in our changeable climate during the summer months. The clothes should be loose, so as not to impede the movement of the limbs, and the vest must not be cut low at the neck, neither should it fit tightly so as to press upon the throat. With regard to the lower limbs, nursery fashion ordains that up to the age of five years, or even later, the child's legs and knees must be bare. Most mothers, presumably for æsthetic reasons, support the custom, and are hard to convince that it can possibly be hurtful. Sturdy children, no doubt, bear the exposure without obvious injury, and the fact that they can do so is invariably brought forward as a conclusive argument in favour of the practice. But many children are not robust and sturdy, and to insist upon treating a weakly child as if he were a strong one is a good way to make sure that he shall never become so. It may be laid down as a rule that children who suffer habitually from cold extremities are not fit subjects for this practice. On account of their languid circulation their susceptibility to chills is great, and they suffer much from gastric catarrhs. Their digestion in consequence is rarely good, so that however much food they may be made to swallow, the wants of the system are insufficiently supplied. To leave such children unprotected against the changes of temperature which they feel so acutely is to do one's best to keep them weakly and ill-nourished in the present, and even to imperil very gravely their good health in the future.

As long then as a child's feet are neglected and allowed to remain cold, whatever care may be taken in other respects, the protection afforded him is incomplete. In cold weather the feet should be felt by the nurse with her hand before the boots are put on, and warmed if necessary, so that the child may leave the house in a fit condition to withstand the change of temperature. This is not a point to be neglected, for with cold extremities the resisting power of the system is reduced to a minimum; and an impressionable or delicate subject who is prone to gastric derangements, as all such children are, will almost certainly be the worse for the exposure if this matter be ignored. In the case of children who suffer habitually from a languid circulation the feet should be examined several times in the day, and carefully warmed if they are found to be cold. Such children should wear long woollen stockings both in-doors and out, and it is important that these overlap the combinations above the knees, so that the two cannot gape apart as the child plays about the room. If the stockings get damp with perspiration, as in under-nourished subjects they are often found to do, they must be replaced by a dry pair directly the child returns to the house.

Exercise.—Sufficient exercise both indoors and in the open air is essential to the furtherance of healthy development. Infants should be encouraged to kick their legs and roll their bodies about on a mattress or thick carpet, making sure, of course, that the child does not lie in a cold current of air from under the door. He should never be allowed to remain for hours together in the daytime covered up in his cot. Carrying him about the rooms in the house and dancing him in the arms is beneficial, not only to his temper, but also to his physical well-being. Crawling, as soon as the child is strong enough, is useful; but a heavy child should not be tempted to try to walk, or even to stand on his feet holding by the furniture, until his second year is well advanced. In infancy the healthiest bones will bend if exposed to too heavy a load before ossification has proceeded sufficiently to enable them to bear with ease the weight of the body. The child, whatever his age, should spend several hours in the open air during the winter months, and in summer should pass the greater part of the day out-of-doors. A new-born infant can be taken out for the first time at the end of the first week if the air be dry and warm; but in winter this step had better be postponed until the end of a month, and a day should be chosen when the air is fairly dry and still. A young child is better at home if there is a cold east wind blowing, or if the air is charged with moisture from melting snow or heavy and continuous rain. For his first outing half an hour is quite long enough, afterwards the time can be gradually extended as he grows older. Objection is sometimes made to a young child's sleeping out of doors, but this I think unreasonable. In any case it is futile, for if we dislike the practice we cannot prevent it; if the child insist upon sleeping we cannot keep him awake, and, indeed, there is no reason why we should attempt to do so. The only precaution it is necessary to take in such a case is to see that the feet of the child are kept warm by thick wrappings or a hot bottle placed against them as he sits or lies in his perambulator.

When able to run about children should be encouraged to join in all lively games in the open air, and every means should be used to strengthen their muscles by sports which tax their agility and dispose to smartness of movement. Those games and exercises are to be preferred which bring into play the muscles of the whole body; those which call only special groups into action are less to be recommended, for the latter, if often engaged in, tend to develop the muscular system unequally, and are unfavourable to symmetry of growth. In the case of very young children with whom walking is a comparatively recent accomplishment, there is one source of evil which may be referred to. It is a common practice to take a young child out of his perambulator or cart, where he has been tucked up warmly in his rugs, and put him on his feet to walk for a time. In wintry or damp weather this practice must not be allowed, except in the case of very strong children. One is very apt to forget, in the first place, how very close their little bodies are to the ground, and in the second, that to remove a susceptible subject from all his warm wraps and set him on the cold gravel or pathway, thus suddenly changing the temperature of his surroundings by several degrees, is likely enough to be the cause of a chill. Many an attack of catarrh, at first insignificant, has been made serious by this means. Except in the warmer months, when rugs are dispensed with, it should be the rule when a young child is to walk out-of-doors to take him out of the house on his feet and forbid his leaving his cart when once settled there.

Control of the Bowels and Bladder.—It is important to train children early to regularity in the movement of their bowels. Infants at the end of the first year can often be induced to make an effort if held over the chamber-pan after their breakfast, and with a little perseverance a young child—even one who is not exceptionally intelligent—soon begins to understand what is expected of him. A great help in promoting the necessary regularity is a clear comprehension of the chief causes of constipation in infants; and if we realise that insufficiency of fluid, excess of starch in the diet, and, above all, chill from reckless exposure are the more prominent agents which bring about this deficiency, we can do much by attention to these matters to make our task an easier one. In hot summer weather when the skin is acting profusely, the stools are apt to be dry and hard so as to pass but sluggishly along the alimentary canal. At this time also the urine is scanty and high-coloured, and often deposits a streak of uric acid on the napkin or at the bottom of the chamber-pan. If this be noticed, it must be taken as a sign that more fluid is required, and the child, however young he may be, should be made to drink cold water, boiled and filtered, out of his bottle several times a day. In hot summer weather cold drinking water is most grateful to infants, and should never be denied them.

In the case of older children regular habits in this respect must be enforced, and every child should be cautioned never to suppress the desire for relief. Exercise is of service in aiding a daily action of the bowels, especially if it include such movements as bring the abdominal muscles into play. The diet should always be attended to. A normally healthy child should take a sufficiency of green vegetables and fruit to his food and avoid excess of starch. A word of warning may, however, be uttered against the incautious use of fresh fruit in large quantity as a substitute for aperients as a means of stimulating a regular action of the bowels. This plan is often adopted without any regard to the general health of the patient or his special digestive capabilities. But, as will be explained later, such things must be given with prudence, for children vary widely in their power of digesting the acid fruits, and a delicate or anæmic child will often suffer greatly in his general health by such well-meant efforts to "do without medicine" in promoting the regularity of his daily relief.

Casual wetting by infants is also to be put an end to as quickly as possible. It is not difficult by perseverance to train young children to empty the bladder at regular times when called upon. By this means we do much to prevent irritation of the buttocks and other ill consequences which are apt to follow lying for hours in saturated diapers ; indeed, an infant so educated will be able to do without a diaper during the daytime and only require one at night.

Sleep.—A sufficiency of sleep should be secured for children of all ages. For the first few weeks an infant will sleep the greater part of the twenty-four hours and only wake up to take food. Even at six weeks or two months the child is awake but a very few hours (four or five) out of the day, and sleeps all night except when waking or when waked for a meal. It should be the aim of the nurse to reduce early the number of meals in the night. An infant of a few months old should require only one meal between ten o'clock at night and five or six on the following morning, and at twelve months should sleep until 8 a.m. without waking for food. In addition, he will require two sleeps, each of an hour-and-a-half or two hours, in the course of the day. These midday sleeps should be continued as long as possible. Most children can be trained to sleep for an hour or so at midday for the first three or four years, but it becomes increasingly difficult to keep up the practice as the child grows. Still, even if sleep will not come, the quiet and rest are beneficial to an active child, especially to a neurotic and impressionable one, and should be continued at least until the child is four years of age.

It is advisable to accustom the infant to sleep in his cot rather than on the nurse's lap, and to go to sleep quietly when laid down. This is largely a matter of habit, and if a healthy infant be laid down after a meal in a quiet, darkened room, with feet properly warm and a napkin properly dry, he usually falls asleep quickly enough. The two chief causes of restlessness at night and disturbed sleep in infants are indigestion and hunger. Infants at the breast who are fed with poor, watery milk, always sleep badly, for they are empty and unsatisfied. Those who are brought up on the bottle and supplied with a food which from any cause is ill-suited to their digestive capacity toss about in their sleep, or wake and scream from indigestion and flatulent colic. So, also, in the case of older children indigestion and acidity will make them twist about, groan, grind their teeth, and mutter in their uneasy slumbers. In all such cases a revision of the dietary and appropriate treatment will soon bring about a favourable change. In many growing boys and girls an inability to sleep after being settled in their beds is often induced by this cause. The children will lie morbidly wakeful for several hours, and be still wide awake at ten or eleven o'clock when their elders are preparing for bed. The same result may be brought about by over-excitement. Young children who have indulged in exciting games just before bedtime, or return tired from a birthday party, often find a difficulty in sleeping after being put to bed, the result of nervous reaction after the strain. The exhaustion of an over-taxed brain in school children is another cause of wakefulness or disturbed sleep. This is much more common in little girls, who are apt to take their education seriously, than in boys, who are more intent upon their games. In the latter it is usually induced by beginning the education at too early an age. Some children's brains develop but slowly, others are curiously and prematurely active. In either case over-pressure of the kind referred to may do very definite harm to the nervous system and encourage many varieties of disturbance. It is then an important matter in nursery management to avoid excessive excitement of every kind, especially late in the day. Children should be forbidden boisterous games in the evening, and allowed only quiet amusements for the hour before they go to bed.

There is one other cause of sleeplessness in the early part of the night which must not be overlooked. Some imaginative children, and these not necessarily the youngest, have a morbid terror of the dark, and cannot bear to be left alone in their bed without a light. It is both cruel and unwise to make little of these nervous fancies or treat them as childish foolishness which may safely be ignored. They must be humoured, for they cannot be removed by argument or persuasion. The child may, perhaps, be silenced by expostulation or ridicule, but he none the less nurses his fears and suffers both in mind and body from the misery of his nightly ordeal. In many children a dread of the coming trouble throws its blight over the whole after-part of the day, so that as evening draws near they may be noticed to become more and more timorous and downcast. The only judicious way of treating these fears is to attempt no remonstrance, but at once to meet the wishes of the child, whether expressed or only guessed at, as if his dislike to the dark were a perfectly natural emotion which must, as a matter of course, be deferred to. A night-light should be provided and continued regularly until the child himself expresses a wish for its removal.

Care must be taken that children of all ages get enough sleep. A young child should sleep soundly for twelve hours, and later, at the age when lessons begin, it is of the utmost importance to see that the brain, upon which such new, and therefore exacting demands are being made, gets a sufficiency of needful rest. Young school children require ten or eleven hours' good sleep, and many will sleep the clock round with advantage. In many schools too little attention is paid to this matter, and the common usage of early lessons before breakfast, begun often at an hour when a boy ought still to be fast asleep in his bed, is not calculated either to sharpen his wits at the time or influence for good his future development.

Rest.—But it is not only the amount of sleep at night which should receive our attention. It is necessary also to arrange for sufficient rest during the day, and while we encourage bodily activity to see that exercise is not carried to an injurious extreme. Growing children, whose spirits and energy outrun their physical powers, must not be allowed from an impulse of emulation to overtax their strength and push muscular effort to the point of exhaustion. A healthy weariness is natural and becoming, but muscular activity carried to the point when all the bodily powers are spent and done is to be condemned as a source of many evils. Not the least of these is distortion of the spine. It should be our care to see that when the body is at rest it does not assume and habitually return to positions which by continual repetition may develop into fixed and unsightly deformities. Mr. Arbuthnot Lane has shown that the double lateral curvature of the spinal column, which is so often seen in weakly and fast-growing children as a result of over-fatigue, is nothing more than a development of a normal physiological attitude into which the back falls naturally when at rest. It only tends to become a fixed distortion when continually repeated, or maintained with little change day after day for many hours at a stretch. In childhood the fibro-cartilages between the vertebræ are very compressible and yield to the weight of the body. The back of a child who is wearied by his day's activity shows an exaggeration of the lumbar and dorsal curves, so that in the evening his height is perceptibly less than when he first rose from his bed. The removal of pressure during sleep enables the flattened cartilages to recover themselves and resume their normal thickness. The difference is more pronounced in weakly children, and is great in proportion to their want of strength. Such children may be noticed during the day to pause at times in their play in order to rest the wearied muscles of the back. The position they then assume, sitting with the legs bent and the body leaning a little forward, develops a curve in the lumbar region with its convexity to the right. When this occurs there must follow, as a purely mechanical arrangement to preserve the balance of the head and upper part of the body, a compensatory curve in the dorsal region with its convexity to the left. These two curvatures, by frequent repetition, tend to become permanent owing to changes set up in the compressed cartilages. It is therefore our duty in all rapidly growing and weakly children to insist upon sufficient rest, and to see that during these periods of relaxation the child lies on his back with the head low, instead of sitting hunched up on a chair or lolling upon a couch. We must also see that when on their feet they do not adopt attitudes which encourage the same deviations from the straight line. They must be prevented from leaning their weight habitually on the leg of one side, or resting as they stand continually upon the same elbow. In cases where the deformity cannot be reduced at once by muscular action or change of position, special exercises by a trained instructor become necessary. The object of these exercises is to strengthen the muscles on the concave side of the curve. They must therefore be carefully devised to bear a due relation to the seat and degree of the weakness to be overcome. On this account the use of the ordinary gymnastic apparatus, such as the high bar and other like contrivances, is unsuited to these cases, and must be strictly forbidden. In these evolutions the stress of work falls almost entirely upon the stronger muscles, which are well able to bear it, and spares the weakened muscles, whose activity it is our special object to promote. Such exercises, therefore, increase the disproportion instead of correcting it.

The feet of young children are not to be neglected. It is an important duty to see that no deformities are allowed to develop which may distort the toes or flatten the instep, for these not only make the gait awkward but hamper freedom of movement. We can prevent the first deformity by taking care that the toes are not cramped by narrow short boots. Mr. Arbuthnot Lane has shown that if the child is allowed to wear too short a boot, or a boot which, originally long enough, has become short through lengthening of the foot by over-exercise, the pressure brought to bear upon the end of the biggest toe induces changes in the metacarpo-phalangeal articulation. The opposed surfaces become flattened and eventually lose their cartilaginous coating, so that the movement of the joint becomes stiff and cramped. If the pressure be applied laterally by a narrow, pointed shoe, the great toe is forced inwards towards the second, so that it comes to lie on or beneath it, and the deformity, at first reducible, tends to become permanent. This is called "the hammer toe." It is favoured by a high instep or a high heel to the boot. A small, tight, narrow boot, however elegant it may appear to the eye, is hurtful to the foot, for it destroys its elasticity by preventing the natural movement upon one another of the bones composing the arch, and hampers the action of the tibialis posticus and other muscles which regulate the movements of the foot. It is in great measure by this unwise compression that the flat foot is developed. A tight, narrow boot so interferes with the natural movements referred to that the adduction of the foot in walking, always an effort to a weakly, rapidly growing child, becomes impossible to sustain for long together, and the weight of the body tends more and more to rest on the inner border of the sole. This position raises the outer border of the foot, depresses the natural arch, and in time creates a position of permanent abduction. All these distortions, as well as those of the spinal column, are favoured by anæmia, rapid growth, and feeble health generally, for it is rare for a robust child to suffer from them. Therefore, the possibility of their occurrence furnishes an additional reason for attention to the means recommended for maintaining health, and opposing the various untoward influences which tend to impair it. When a child discards his baby socks for leather foot-wear we must see that his shoes and boots are broad at the sole and long enough in the foot not to set up pressure on the end of his toes. Very young children should wear no heels, and their boots should be "rights" and "lefts," and not such as can be worn on either foot indiscriminately. Sandals are often recommended, and so far as they prevent any squeezing of the feet are no doubt of service. The disadvantage is that they leave the feet exposed to all changes of weather, and are therefore ill-suited to children whose extremities are habitually cold.

Diet.—It does not enter into the scope of the present article to describe the method of artificial feeding in the infant. This important subject is dealt with fully in another article.

At the age of fifteen or eighteen months most children have been weaned from their bottles, and all have begun to require a greater variety of food. At this period the digestion is more vigorous, the salivary secretion is copious and active; the cutting of the milk teeth is advanced; and the general system is prepared to profit by a judicious extension of the hitherto limited list of articles which are held to be appropriate to the dietary of a young child during the earlier months of life. The first innovation upon a purely milk and starch diet is a cupful of veal or chicken broth. This may be given as early as the end of the first year, and should be, to begin with, of the strength of ½ lb. of meat to a full pint of broth. It is more nutritious if thickened with barley and strained. To this may be added some sopped stale bread or rusk. If, as may happen, the child should show any dislike to the new and unusual taste and refuse to take the broth, it must be flavoured to suit his palate; and I have found that if well sweetened with turnip it will be taken by most children without any objection. At the age of eighteen months the yolk of a new-laid egg may be allowed two or three times a week. This may be either very lightly boiled and eaten with thin, well-buttered stale bread, or beaten up with broth or milk. By the middle of the second year, too, the child may take a small quantity of crumb of bread soaked in the liquid fat of fried bacon as an addition to his breakfast; and about this time he will be found to digest well a light pudding made of sponge cake or rusk given two or three times a week. At sixteen or eighteen months old he may take a little mutton or chicken at his dinner. A good-sized mutton chop, from which all fat and gristle has been removed, is grilled quickly over a very hot fire. This hardens the outside and leaves the interior underdone and full of juice. The soft inside is finely minced, pounded in a mortar and rubbed through a wire sieve, so that all fibre is retained and nothing passes through but the pulp of the meat. This is most nutritious and digestible, and may be allowed twice a week hotted up with broth or gravy. With it may be given bread-crumb and some vegetable, such as cauliflower, vegetable marrow, well-boiled cucumber or large Spanish onion. It must be noted that the latter requires very careful cooking. For a child of eighteen months or two years of age the onion must be stewed for six hours, changing the water every hour. The object of the frequent changes of water is to remove the objectionable elements and convert the vegetable into a bland unirritating substance without depriving it of its nutritious qualities, and thus prepared, it very rarely fails to agree. Well-boiled potato may be allowed, but should not be given every day as it is a much less desirable vegetable for daily use than those mentioned. Overmuch starch is to be avoided in the diet of young children. This is a matter of no little importance; indeed, a main object of the changes above described is to free the child from this surplusage of farinaceous food. A growing infant, after the age of twelve months, requires a more liberal dietary, for excess of starch tends to make him fat and heavy and lethargic without giving him strength in proportion to his size. It over-nourishes his adipose tissue at the expense of his muscles and his bones. A big, fat child of this age is rarely as strong as he looks—in fact, many of the infants whose size and plumpness are the admiration of their friends will be found on examination to show some of the early signs of rickets. On this account milky puddings made of rice, tapioca and other farinaceous substances, although supported by long years of nursery prescription and tradition, are less to be recommended than puddings which are made of flour, biscuits and rusks. These latter contain starch, it is true, but they also contain albuminoids and mineral matter, including phosphates, and thus supply material for the full nutrition of all the tissues of the body. The purely starchy puddings may be given occasionally—twice a week or so—but they should never form the bulk of the meal as they too often do.

All changes in the diet when they are made in the ordinary course of progress must be made with caution. It is important to choose a time when the child is lively and cheerful, sleeping well, and taking his food with appetite. If he be feverish or upset with teething or in any way indisposed, it is necessary to wait until the temperature has returned to a normal level and all signs of disturbance have disappeared. Each change must be made singly, and we must be satisfied that it agrees before we proceed further. This caution, however, is only necessary when the infant is young and the changes made are those rendered advisable by a normal digestive development. In cases where a child has been restricted to an infant regimen of milk and starch long after an advance should have been made to a more liberal list of foods we are justified in acting very differently. We may then without any misgivings proceed at once to a diet which includes bacon fat, lightly cooked yolk of egg, pounded mutton or chicken, and plaice or whiting boiled and minced; and if we are careful so to arrange the daily menu that too many of the more solid articles do not enter into the same day's dietary, we need have no fear that the issue of the experiment will be anything but satisfactory. For instance, it is well when introducing this change of feeding to set down the egg and pounded meat for different days, and to arrange for fish to be taken on a third day, when neither of the preceding is chosen. The bacon fat may be allowed every day; the egg twice or three times a week. One of the vegetables already recommended should be always included in the food list for the day, as this forms an important addition to the diet. A good breakfast three times a week for a child of three years is egg and bacon fat taken together. The solid hot bacon fat is to be finely minced. The egg is to be partially cooked by placing it in a saucepan on the fire and allowing the water to come completely to the boil. It is then removed while the yolk and white are still unset and is broken over the bacon on the plate. Bread-crumb may be added when it is eaten. On other days the child may take bread-and-milk, hominy, quaker oats and well-boiled porridge.

When the child is between three and four years old the meat should be finely minced instead of pounded, and every effort must be made to encourage a proper mastication of food. Mutton is the best meat until the child reaches the age of five years. He may then begin to take the under-cut of a sirloin of beef. It is important to keep in mind the value of variety in our choice of foods, as both appetite and digestion are thereby encouraged. For this reason brains, sweetbread and tripe may be included in the menu from time to time. Much stress is often laid upon the importance of using only fresh-cooked meat in the feeding of children and upon the indigestible nature of meat which is cooked a second time. There is no doubt that meat hardened in fibre by this means is inadmissible for use in the nursery, but dishes such as hashes and stews in which the meat is merely warmed through without being really cooked again need not be excluded. Most of the salted things agree well with young children, and after the age of three years it is quite permissible to tempt a poor appetite with small quantities of soft bloater, the bones, of course, being carefully removed, or bloater or anchovy paste on thin bread-and-butter. Sardines of a good brand are also unobjectionable. I have heard surprise sometimes expressed at the inclusion of such articles in the dietary of a young child; but if of good quality and given in moderation these things rarely, if ever, disagree; at least, after an experience of many years, I am unable to recall a single instance in which they have done so. I may say, too, that they are perfectly suited to children of feeble digestion who, on account of this weakness, are unwisely restricted to a diet of milk and starchy foods. Such children, who are upset at once by a rice pudding, will take bacon or a portion of a bloater at their meal and be afterwards lively and active instead of lethargic and dull. In the feeding of young children we are still too much tied and bound by the trammels of nursery tradition. For a long time now I have been advocating a change in this respect, and have argued that a mixture of milk and starch is ill-adapted as food to a disordered stomach, or to one whose digestive activity has for any reason become temporarily impaired. Against this view the case of a strong child with a vigorous digestion is usually quoted, and there is no doubt that such a child can dispose of this or any ordinary food without difficulty. But, as I have said before, it is illogical to argue from a robust child to a weakly one; and even a robust subject may have his digestion upset by chill or other cause, so that his customary meals will cease for the time to agree. He, too, will then require a careful diet, and the dieting should take the form of rigid restriction of the fermentable parts of his food. Now, there are few substances more readily fermentable than that formed by a mixture of sweetened starch and milk cooked together in the oven. It is the combination of the two which is so apt to disagree even in cases where either can be taken singly without ill consequences. Plain boiled rice, as in a mild curry, often agrees well, and tapioca used as a thickening to soup is digested without difficulty. Milk, again, taken plain as a drink at breakfast and tea time, is healthy and nourishing; but cook the milk and starch together, with added sugar, as in a farinaceous pudding, and few dyspeptic subjects of any age can take it without immediate flatulence and discomfort. The same care must be taken in the matter of acid-containing fruit, such as baked apples, oranges, grapes, and all the summer fruits. All these agree, as a rule, with healthy digestive organs, at any rate if taken early in the day, and are useful additions to the diet ; but anæmic children, who are easily upset, and are therefore frequent sufferers from disordered stomach, can only take them when their health is at its best. If given at other times the fruit is only too likely to set up an acid change in every fermentable thing which the stomach may contain at the time. Attention to these matters is of the utmost importance, for the health and normal progress of the child are dependent upon the exercise of judgment in his management, and a willingness to recognise a distinction between the hardy and frail. If all are treated exactly alike, the weaker are bound to suffer.

There is another matter which must not escape our attention, and that is the arrangement of the meals. Here, again, judgment is required, for all children cannot judiciously be treated on the same plan. The arbitrary rule which prescribes a substantial breakfast at eight o'clock, a solid dinner at midday, and afterwards nothing but milk with bread-and-butter, cake and jam until the following morning, is an arrangement which, although sanctioned by custom, is not always to be recommended. It may not be obviously hurtful to a hardy child, who, whenever a meal-time comes round, is prepared with an appetite to meet it, but to others who are not so fortunate we must be ready to make concessions. Anæmic, under-nourished children, for whose special wants it should be a definite purpose of all nursery arrangements to provide, cannot be treated with advantage upon these hard-and-fast lines. It is common enough for such children to refuse their breakfast, eat very little of their dinner, and that only under great pressure, but towards evening, when nothing lies before them on the table but bread-and-butter and cake, to be ready, if permitted, to do justice to a more sustaining meal. Where this is the case it is wise to recognise such individual needs, and to supply the chief meal of the day at a time when it has been shown to be acceptable. I have followed this plan for some time now with children of six years and upwards, and have found that if sweets and potatoes are withheld and a good hour is allowed for digestion before the child is prepared for his bed, nothing but good has resulted from the experiment; in fact, I have come to expect an expression of satisfaction from the parent at the benefit derived by her child from this new arrangement of his meals. A little alcohol is sometimes useful in these cases to give an impulse to digestion, but is not to be prescribed recklessly or ordered merely because a child is anæmic and thin. In early life alcohol should be regarded strictly as a medicine, to be used only for its therapeutic properties. Being a stimulant and not a tonic, it is given only for its immediate effects, and should be left off when it has served its purpose and the appetite has improved. The best stimulant for infants is the brandy-and-egg mixture of the British Pharmacopœia. Older children do better, perhaps, with a sound port—2 to 4 teaspoonfuls once or twice a day.

A word may be said as to the quantity of food to be allowed to a growing child. In this matter it is impossible to lay down broad rules which will apply to all cases, for the quantity which will be appropriate and useful in any individual instance is determined partly by the immediate wants of the system, but chiefly by the special activity of the digestive organs. If more be taken than these can dispose of without effort, the result is indigestion and discomfort. If after a meal a child be left lethargic and dull, with a muddy tint of the face, marked especially about the forehead and eyes, it is always desirable to make some inquiry as to the quantity and kind of food he has been taking. A child who is habitually over-fed is usually slow and indolent both in mind and body; if made to run he complains of a stitch in his side; his water is often thick; he is long in going to sleep, and when asleep tosses continually about, moaning and groaning and grinding his teeth. Much harm may be done by the practice of allowing sweet cakes and sweets to be eaten between meals. Such things tend to spoil the appetite and make digestion slack, so that after the next meal the stomach is likely to feel over-burdened, although no more may have been taken than in the absence of these indulgences could not have been deemed excess.

Special Considerations with Regard to Treatment in the Child.—On account of susceptibility to atmospheric influences in early life and the special vulnerability of the digestive organs, disturbances of nutrition form a large proportion of the complaints which we are called upon to treat during the first few years after birth. A judicious regulation of the diet takes therefore an important part in the management of these derangements, and in our choice of foods we must be careful to see that nothing is allowed which is capable of furnishing material for the generation of acid and gas in the alimentary canal. Such things contribute little or nothing to the nutrition of the patient, while they do much not only to increase his discomfort, but even to imperil his chances of recovery. This subject has already been enlarged upon, but I may be permitted once again to insist that in this matter we must have the courage of our convictions, and not hesitate to put on one side nursery tradition and precept whenever it is found to conflict with the maturer knowledge derived from modern experience.

There is a common error in the management of young patients during convalescence from the infectious fevers and other forms of acute illness which it may be well to refer to. It consists in forcing upon the patient large quantities of food without any regard to the ability of his digestive organs to deal with it to advantage. In the case of measles, for example, I have seen many cases where a convalescent patient has been kept for days together in a state of high fever, while still confined to his bed, by being made to swallow food in excessive quantity—in quantity which even a growing child in rude health and active exercise would find it impossible to cope with. When stated thus baldly the absurdity of such a course becomes manifest; but in practice the mistake is often made, the reason being, no doubt, that the regulation of quantity is too often left by the attending practitioner to the nurse in charge. But food should never be forced upon a child whose tongue is dirty and whose appetite is poor. It is only when the tongue is clean and the patient is showing an interest in his meals that we are justified in supplying food with any approach to liberality. But it is not only the actual digestive capacity of the patient which requires constant attention. In the whole management of disease in early life we must never fail to ascertain the presence or absence of gastric derangement, for our choice of remedies is largely influenced by the state of the digestive organs. This is especially the case when it is a question of the employment of invigorating measures, for much harm may be done by the premature use of tonics, especially of the iron preparations. A good illustration of this may be seen in the case of anæmic, delicate children who suffer from repeated attacks of gastric derangement. When, as often happens, these attacks recur frequently, the intervals are too short for the digestion completely to recover its tone before the next attack begins, so that the derangement, although it may be better and worse, never entirely disappears. In such children the pallor is often great, and this and the evident weakness suggest at once to the medical adviser the necessity of a course of tonics. But iron and other similar remedies, however perseveringly they may be given, produce no good result; indeed, a common consequence is that the patient's condition becomes less and less satisfactory as the days go by. For a tonic to be useful the tongue must be clean. As long as any sign of indigestion continues—shown by loss of appetite, muddy complexion, excessive irritability and peevishness, and disturbed sleep—only alkalies and aromatics should be given, following a mercurial purge. The main treatment must consist in regulation of the diet and special observance of all the precautions recommended for the avoidance of chill. The value of alkalies in the treatment of disease in the child must never be forgotten, for there are no drugs more useful than these in the management of their complaints, especially of the gastric derangements which form so large a proportion of their ailments. By the use of these remedies we arrest catarrh of mucous membrane, check excessive secretion and at the same time reduce acidity. Their value is increased by the addition to the prescription of warming aromatics and antiseptics (ginger, cardamoms, cinnamon, spirit of chloroform, etc.), which help to dissipate flatulence and lessen the discomfort of the patient. In prescribing the alkaline remedies we must bear in mind the object with which they are given, for when that object has been attained—when the catarrh has subsided, leaving the mucous membrane flabby and relaxed—their usefulness is at an end. When the tongue cleans or is left flabby and pale with indented marks at the sides from the teeth the time for tonics has arrived. We should also notice the urine at this time, for alkalies rarely do good when the water is habitually alkaline or neutral.

When tonics are given with judgment they agree well with children. Iron, the mineral acids, the vegetable bitters and quinine are all of service. Quinine is of especial value during convalescence from acute disease. The dose should always be substantial, for young people take quinine well, and seldom feel the uncomfortable consequences from it which are sometimes met with in the adult. I rarely give less than 1 gr. even to an infant of twelve months old, and in prescribing it in doses of 2, 3 and 4 gr. several times a day to children of three or four years old have never seen any sign of cinchonism. This remedy is especially required during recovery from the infectious fevers. In the convalescence of measles, in particular, quinine should always be given, as its value in this disease is exceptionally great. Strychnine is also a useful tonic in all cases of debility and depression. An infant of six months will take ♏ $\frac{1}{4}$ of the solution [U.S.P. gr. $\frac{1}{480}$] three or four times a day with advantage, and if greatly prostrated, as in the collapse of septic diarrhœa, can perhaps be roused to some semblance of vitality by a hypodermic injection of the same strength given every hour for several doses. Its stimulating effect is increased by the addition of 2 or 3 drops of sulphuric ether. Cod-liver oil is a favourite remedy with some practitioners, but like the tonics, it must be given with judgment and should never be prescribed merely because a child is pale and thin. At no age have young children a great capacity for digesting fats, and the oil can never take the place of nourishing food. It should only be prescribed when the tongue is clean and the digestion in good order, and the dose to a young child should be measured rather by the minim glass than the teaspoon. For a rickety infant 10 or 15 drops is a sufficient dose, and no child should be given more than a teaspoonful at one time. This quantity may be repeated, if thought desirable, two or three times a day.

Alcohol, although not a tonic, may be referred to in this connection, for its value in all cases of weakness and exhaustion can hardly be over-rated. Children of the poor who have been exposed to all kinds of privation often show little or no response to treatment until their flagging energies have been aroused by a few doses of port wine or brandy, and a child whose first steps in convalescence from acute illness have been faint and uncertain will often begin to make rapid progress under the influence of the same treatment. The dose must in each case be regulated with due regard to the age of the patient and his degree of weakness. The greater the prostration the more liberally must the remedy be prescribed.

A word may be said as to the dosage of medicines for children. Many drugs are given in too small quantity to be of much benefit. The object of their administration is to control symptoms or make a definite impression upon disease, and the quantity which will do this cannot always be regulated by the age of the patient. There are few medicines to which young children are acutely susceptible: many they can take in doses as large as or even larger than can be readily borne by the adult. To opium, as is well known, a child is highly responsive, and this remedy must always be given with caution in early life. Still, it is as valuable in the treatment of the illnesses of childhood as it is in similar complaints in adult life, and may be prescribed without risk if the dose be moderate and be repeated at sufficiently long intervals. A child must never be roused from sleep to take this medicine, and it must not be given at all if he is drowsy. The dose may be calculated for an infant at ♏ ¼ [U.S.P. ♏ ⅛] of the tincture for every three months of life. In certain conditions, however, the remedy may be pushed more boldly. If the patient is suffering great pain from severe abdominal colic or acute visceral peritonitis there is a certain tolerance of the drug; but it is wise to press the sedative not by increasing the dose but by giving the original quantity at shorter intervals. If we do this, noting the effect and especially watching the pupils, we need have no fear of doing harm.

Lead is a remedy which children take badly; indeed, I am of opinion that it is inadmissible for infants, and should only be given to older children with great caution. Fortunately, lead has almost ceased to be used as a remedy for diarrhœa, although its astringent effects have not been surpassed by any of the modern intestinal styptics. Its employment is now confined chiefly to local application. To chloral children do not show the same susceptibility that they do to opium and its alkaloid morphia. Chloral hydrate and butyl chloral, and also chloretone, are given chiefly for their anti-spasmodic properties, and infants of twelve months old will take 1 gr. of the two former or ½ gr. of the latter, three or four times a day, in cases of whooping cough or spasmodic croup without showing any sign that the dose is an extravagant one. In prescribing these sedatives to a young patient it is advisable, as in the case of opium, to give a small dose frequently repeated rather than a large quantity at longer intervals. In the case of most drugs the dose ordered for a young patient must be reduced, of course, below the standard required for a full-grown person, but still need not be excessively minute. It is best to order ¼ or ⅛ part of the quantity reckoned suitable for an adult. But it is not necessary to take this precaution with all drugs. Some, such as the iodides and bromides and antipyrin, as well as quinine, may be given with liberality. I have never seen iodism produced in a child by even large doses of iodide of potassium, and I rarely order a smaller quantity than 5 gr. even in the case of a child of eighteen months or two years of age. The only precaution which I think it well to take, if the remedy is to be prescribed in full doses, is to use the iodide of sodium, on the ground that the salts of soda are less likely to depress than the corresponding salts of potash. For this reason the sodium chlorate is always to be preferred to the potassium chlorate, whenever the remedy is required to be taken in ¼-drachm doses frequently repeated, as in ulcerative stomatitis. Antipyrin may be given to young people in the same doses as recommended for quinine; and the bromides I have never seen do harm whatever may have been the dose prescribed.

There are other drugs which most young children will take in larger quantities than can be borne by the adult. Belladonna and its alkaloid belong to this class. Ten [U.S.P. fourteen] drops of the tincture of belladonna or gr. ¼ [U.S.P. gr. ⅕] of the alcoholic extract may be considered an ordinary dose of the remedy for a young infant, and if the patient shows no sign of irritability or excitement after taking the medicine—and very few do so — the dose may be pushed much further without fear of doing harm. It may be mentioned that the "belladonna flush" is very readily induced in some children by a very moderate dose of the drug, and is not to be taken as a sign of warning, for it is no indication that the dose has been excessive. The same child who has flushed a brilliant red after a small dose will take the same remedy in larger and larger quantities before any impression is made upon the iris, and dilatation of the pupil is the earliest sign that the system is responding to the action of the drug. In giving belladonna for its sedative effect in epilepsy, chorea, enuresis, etc., the dose should always be pushed to the point of producing this effect. It may be then continued in slightly reduced quantity as long as may be necessary. Arsenic is also well borne in early life. A child of seven or eight years old will take, as a rule, 5 to 10 drops of Fowler's solution, if well diluted and given immediately after a meal, without any sign of discomfort, and the dose may be repeated three times a day. Still, as in the case of other drugs, there are differences amongst children in this respect, for some are more susceptible than others. It is well, therefore, to begin with small doses and gradually increase.

Ergot of rye all children take well, and in giving it for its curative effect in chorea—and there is no drug I know of .which is more useful in this disease—the dose must be pushed boldly to produce the desired effect. Beginning with 5 gr. of ergotin every three hours in the day and twice at night, the dose may be increased by additions of 2 gr. every three or four days until it reaches 12 gr. In some cases it may be necessary to repeat this dose every two hours in the day before any definite improvement is observed. The only physiological effect I have noticed has been a lowering of the pulse in frequency, but this seems to be of no moment, and should not be allowed to affect the treatment. When improvement begins it usually proceeds apace. Mercury is another drug which children are supposed to take well, and certainly there is difficulty in salivating a child; but the remedy has a very destructive action upon the red corpuscles of the blood, so that after a course of the drug the child is usually left in a state of profound anæmia.

External Applications.—In the treatment of disease in the child the value of applications to the skin, whether in the form of counter-irritants, or baths, or inunctions, must not be forgotten. The impressionable nervous system at this time of life gives an especial value to the use of counter-irritants, and few practical physicians will care to dispute the efficacy of such applications in pericarditis, catarrhal pneumonia, pulmonary atelectasis, general collapse, and many other conditions. In acute rheumatism a timely blister to the precordial region has often averted an attack of pericarditis; the energetic use of mustard poultices to the chest and back is of the greatest help in the treatment of catarrhal pneumonia, acute bronchitis and collapse of the lung; and the influence of mustard baths in rousing young children from a state of profound collapse must have impressed everyone who has seen this method of treatment in operation.

Baths are of great service and may be warm or cold. Cold or cooled water is useful in reducing the temperature in hyperpyrexia. For this purpose the water may be used in the form of baths or rectal injections, or mere sponging of the surface of the body. In doing this regard must always be had to the degree of strength of the patient, for a sick child, if acutely ill, is very readily depressed and may be thrown into a state of profound collapse by too sudden a shock. I have found that it is rarely safe to use water of a lower temperature than 80° F. This may be employed as a bath, but I prefer as the safer process to wrap the child in a sheet wetted with water at this temperature, and cover loosely with a dry sheet; or, better still, to use the water as a rectal injection. This latter method is a very useful way of lowering the temperature; but whatever be the system adopted, it is wise to give a stimulant before beginning the process, and another, if necessary, when the child is returned to his bed.

Cooled water may be used externally in another way when we desire to restore the elasticity of the skin in cases of septic diarrhœa. In this disease inelasticity of skin is a symptom of the worst augury, for unless it can be remedied death is inevitable. The water used is of the temperature of 65° F., and should contain ⅛ part of brandy. A sheet wrung out of this mixture is wrapped round the patient, who is then covered closely with blankets. The cold sheet quickly becomes warm and acts as a poultice to the whole body. The child is to be kept thus swathed for twelve or twenty-four hours or longer, being removed every three or four hours, rubbed dry, and then re-packed as before. The only precaution which it is necessary to take is to watch the temperature, for if it rises under this treatment, the child must be released at once and the plan abandoned for the time. The effect of the process is to restore the action of the kidneys, which for the time is practically suspended. If this can be done the normal elasticity of the skin returns and the prospects of the patient are very materially improved.

Warm baths are used for their soothing influence in all cases of nervous excitement and spasm. In cases of reflex convulsions they have come to be the ordinary domestic remedy to be employed without the loss of a moment, and are at least harmless if of no very striking benefit. In local spasms, such as spasmodic retention of urine from spasm of the neck of the bladder, they have a very definite value, and will usually bring this distressing symptom quickly to an end. So also in the constipation which is induced by spasmodic contractions of the bowel in young children a warm bath is often followed by a copious evacuation after aperients have been given in vain.

Inunctions of oils and fats are sometimes useful. By this means a certain amount of nourishment can be introduced into the system, and inunctions of cod-liver oil are sometimes ordered with this object. The process is hardly an agreeable one on account of the objectionable smell of the oil, but this drawback is removed by using one of the sweet oils, such as pure olive oil. This conveys an equal amount of nourishment, and has the advantage of being odourless. The external application of oil is also useful in cases of long-standing disease, when the skin has ceased entirely to act and has become rough and dry. It is important in such cases to restore early its suppleness to the skin and encourage its action. This may be done by anointing the surface at night with warm olive oil after a thorough washing in hot water, and placing the patient wrapped up in a blanket in his bed. After a few nightly repetitions of this process the skin loses its roughness and scaliness, and then quickly recovers its normal functions.

It is unnecessary to do more than refer to the inunction of medicated fats, such as mercurial ointments, as their usefulness is generally recognised. Employed in this way mercury is often better borne than when taken by the mouth, and this manner of using the drug is a welcome resource when the ordinary method of administration upsets the stomach and causes nausea and vomiting. Quinine may also be administered in this manner: 20 gr. of the alkaloid are used to 1 oz. of fresh lard. Of this a portion the size of a large cob nut is rubbed into the skin of the arm-pits or at the back of the knee-joint once or twice a day.

EUSTACE SMITH.

SURGICAL TECHNIQUE.

OPERATION ROOM.

It is not the intention of this article to describe the operating theatre of a hospital. The surgeon must not forget that first-class work can be done in surroundings that are apparently forbidding, provided that he himself is sufficiently educated. If time and circumstances allow, a room can be prepared adequately as follows. Before an intended operation the carpet should be taken up, pictures and hangings removed; shelves, curtain-rods, globes, and all else that cannot be removed should be dusted; then the floor should be scrubbed with carbolic acid (1 in 20). It is not necessary to fumigate the room. If time and circumstances do not allow this preparation it would be wise to do nothing, for a partial preparation would disturb and distribute dust which had better be left where it is. One good-sized table washed with carbolic lotion (1 in 20) should be placed against the wall to accommodate dressings, etc., which have been sterilised in tins: these should never be placed on the floor, as is so often done. One small table similarly washed should be provided for the anæsthetist. The surgeon requires two small tables, one, the larger, for the instrument trays, the other for the use of the assistant who has charge of the swabs; both tables are washed with carbolic (1 in 20) and covered with towels wrung out of 1 in 20 solution of carbolic acid. These tables should be placed towards the foot of the operating table, so that the patient cannot cough or vomit over them while under the anæsthetic.

The temperature of the room should be between 65° F. and 70° F.

The Operating Table, which is easy of improvisation if necessary, is to be covered with thick blankets; a small pillow to support the lumbar spine will minimise the backache which is so often the only condition of which a patient complains after an operation. Hot-water bottles should be prepared. These can be employed to warm the operating table before being put in the bed that is to be occupied subsequently; they are to be removed from the table before the patient is put upon it, as an unconscious patient should never be exposed to the risk of contact with a hot-water bottle. No hot-water bottle should be left in bed with an unconscious patient.

Bowls and Dishes.—All bowls and dishes to be used in connection with an operation are to be boiled for at least half an hour in a solution of salt and water. After boiling they are to be placed upside down on a table covered with a towel wrung out of carbolic acid (1 in 20), and themselves covered with such towels until they are required. No finger should touch the inside of a bowl after it has been sterilised.

Ligatures.—Silk and catgut are employed. The **silk** should be just thick enough to bear the strain it will be subjected to, so different sizes will be required for different purposes throughout the operation. I use the size 00, and if a single thread of it is too weak two or three strands may be tried; this saves sterilising a variety of sizes. Having experimented with most varieties of silk ligatures on the market, I have come to the conclusion that nothing is so safe as Japanese silk. It is to be boiled in plain water for at least half an hour before use, and after boiling kept in carbolic solution (1 in 20) during the operation. Personally I seldom use **catgut**, even in septic cases; if the surgeon prefers it he should make himself responsible for its sterilisation, as some of the catgut on the market is not sterile. The surgeon can quickly and certainly sterilise the catgut by boiling it. The only catgut I know of that withstands boiling is Van Horn's, which is sold in thick glass tubes, which can be boiled before being opened.

Sutures (horsehair, silkworm-gut, silk, silver-wire), **Screws, Pegs** are to be treated in the same way as silk ligatures. Silkworm-gut and horsehair are especially useful for skin sutures.

Silk is also used for skin sutures. It is a fact that no bacteriologist would be surprised to find any skin suture infected after it had been in use for three days. This being so, it would appear wise not to use a material for skin suture like silk, which has a greater power of absorbing serum than silkworm-gut or horsehair.

Needles, Knives and Scissors should be thoroughly scrubbed, laid in pure carbolic acid for a minute or so, and then placed in carbolic solution (1 in 20). Alcohol must not be regarded as an efficient sterilising agent.

All Other Instruments, after being scrubbed with a nail-brush, are to be boiled for half an hour in salt solution and laid out in carbolic (1 in 20). In this procedure, and in all others where boiling is employed, the flame should be distributed properly over the bottom of the steriliser; a small jet applied to the middle of a large vessel does not insure boiling of all the water. In the preparation of an operation the forceps seen in Fig. 1 are valuable.

Lotions.—All lotions are to be made from boiled water. The boiled water is to be kept till required, as much as possible, in the vessels in which it was boiled, any exposed surface of water being protected by a covering of cloth or gauze wrung out of carbolic (1 in 20). The proportions of water and of chemical are to be measured carefully and accurately in all circumstances. When a lotion is not sufficiently warm and warm water is added to raise the temperature the lotion is weakened; therefore warm lotion of the proper strength, not merely warm water, is to be added, or a fresh lotion must be made.

The essential lotions are: (1) Lister's strong lotion, which consists of equal parts of carbolic acid (1 in 10) and perchloride of mercury solution (1 in 250), so that the mixture contains perchloride of mercury at the strength of 1 in 500 and carbolic acid 1 in 20; 2 pints should be prepared: (2) carbolic acid (1 in 20); 8 pints suffice for most operations: (3) perchloride of mercury (1 in 4,000); 12 pints may be required to supply adequate changes of lotion throughout the operation. An operator can insure safety with these lotions. Their detailed use will be described later. There are many proprietary and non-proprietary lotions on the market, most of them impure preparations of the coal-tar series, which have ephemeral vogues; some of them may be dependable, some decompose very readily.

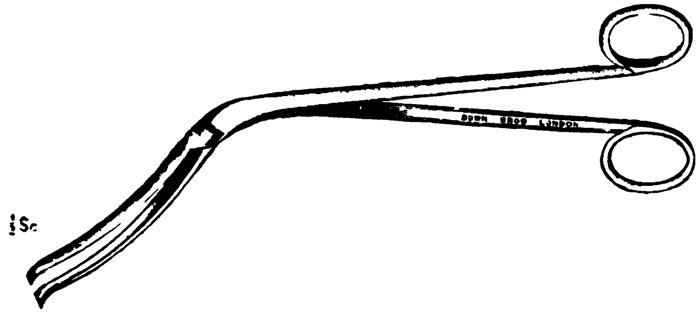

FIG. 1.—The only pair of forceps on the market which can pick up needles as well as big instruments, bowls, towels and swabs, etc. It saves the use of fingers.

Towels.—At least a dozen should be provided, boiled in salt solution for half an hour, and then placed in perchloride of mercury solution (1 in 4,000) until the surgeon wrings them out for use.

Alcohol is not a powerful enough germicide to be used alone for sterilisation: personally I never use it for any such purpose.

Acetone is a most useful preparation for removing the grease and for washing the skin before using Lister's strong mixture.

Iodine, in about 2 per cent. solution in benzol or acetone, or even the pigmentum iodi, is being used very much just now, and with justifiable confidence, as a means of rendering skin safe for surgical interference; it is painted on the night before and again immediately before the operation.

Cyanide Powder and Paste are very useful applications for the skin near septic orifices, and aid the maintenance of asepsis when wounds are made near them.

SURGICAL DRESSINGS.

It should be remembered that surgical dressings are not official preparations, a fact which allows dressings to be put upon the market which cannot be trusted, the chemical being frequently deficient in amount or irregularly distributed, and the gauze itself of inferior quality. Recently I directed an exhaustive inquiry into the subject in all its bearings. As a result I am convinced that the surgeon and the patient will not be protected sufficiently until surgical dressings are made official pharmacopœial preparations, and so given the full advantage of legislative control.

Speaking generally, the products of our leading firms are trustworthy, especially when they are of all-British manufacture, although the gauze is too frequently coarse in type. This cannot be said of not a few Austrian and German products; the material is poor, the chemical process partial or ineffectual, or fraudulent. Some of our firms of less standing depend on these foreign sources for the dressings they sell; or inferior dressings are often sold as " brands " of established articles. While, in the meantime, the surgeon can protect himself and his patient by dealing only with firms of wide repute and by avoiding dressings sold under fancy names, he ought to know the characteristics of a good surgical dressing, efficiently impregnated with the chemical employed, and a ready means of detecting ignorance or fraud.

The properties required of the material of a gauze or wool are softness, fineness of texture and absorptiveness. The last property is the most important, as impregnation with the chemical is more thorough and permanent the more absorptive is the material, and discharges are taken up better. When the material has a low absorptive index the fluid with which it is treated does not permeate it: the active principle is not carried into its substance, but remains merely deposited on the surface after drying, so it is apt to fall off in the subsequent sterilisation and handling, impairing the antiseptic value of the dressing. Softness is a very desirable property in a dressing. Even in the matter of mesh standardisation would be advantageous; a good gauze should have a small, even mesh. (Examples of gauzes on the market are given in the accompanying illustrations. *See* Fig. 2.)

More important than the material of a dressing is the thoroughness and permanency of the chemical process to which it is subjected. The surgeon ought to feel assured that the full amount of the reputed active principle is present, and that the active principle is evenly diffused throughout the material. Improperly prepared solutions may fail to permeate even a good material. In that case the active principle merely adheres, falling off after the material has been dried. Defective processes are apt to cause areas in a gauze to which the chemical solution has only partial access.

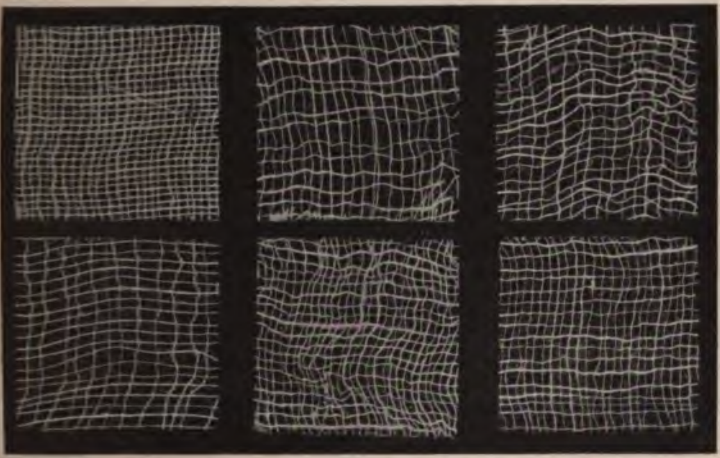

FIG. 2.—The gauze in the top left corner is the best; it has a small even mesh. The others are the commoner types now on the market.

All medicated dressings are prepared by immersion. Sometimes gum damar, resin or hard paraffin is added to the solution of the active principle; these are unnecessary and undesirable additions.

Compressed dressings have the great advantage of convenient storage and portability, but they do not appear to me to be of advantage in ordinary civil surgical work.

Double Cyanide Gauze and Wool should contain 3 per cent. of the double cyanide of mercury and zinc. I have found as little as 0·68 per cent. When the material is of good quality and the salts are pure these dressings are not irritating. The gauze may be kept in carbolic or perchloride solutions ready for use, provided that the lotion merely covers it; for when the lotion is in such quantity that the gauze floats about in it, the active principle is very liable to be dissolved out.

The following interesting experiments were made upon cyanide gauzes and the powder:

That the distribution varies was shown by the following amounts of cyanogen found in two parts of the same roll, within a yard of each other: (1) ·140 per cent.; (2) ·117 per cent.

It was first necessary to ascertain whether the *composition* of the double cyanide itself altered during sterilisation. For this purpose a portion of the well-sampled powder (prepared by Morson's) was sterilised in the manner used for gauzes for one hour in the steam steriliser, the powder being placed between folds of cloth.

(1) The composition of the powder before and after sterilisation was found to be as follows:

Before.—Mercury = 24·20 per cent. to 24·70 per cent.; zinc = 36·07 per cent.; cyanogen = 34·58 per cent.

After.—Mercury = 24·30 per cent.; zinc = 36·88 per cent.; cyanogen = 34·00 per cent.

It was thus found that the powder did not alter materially in composition during sterilisation, any change being in the direction of a slight loss of cyanogen, amounting to about ½ per cent.

(2) The powder was found to have retained its colour.

(3) The water resulting from condensation of steam was collected, and on testing was found to contain a small quantity of cyanide, but no mercury could be detected. Since the double cyanide is very insoluble in water, this would suggest that the action of the steam is mechanical in occasioning any loss.

Double Cyanide Gauzes.—It was found that the distribution varies considerably in different parts of the same roll of gauze, making allowances in the experiments for this fact.

A sample of gauze obtained from a firm was examined before sterilisation by heat and gave 1·37 per cent. cyanogen, corresponding to 3·8 per cent. double cyanide, in one part, but a lower percentage in another.

After sterilisation the gauze was examined and found to contain only about ·4 per cent. double cyanide. The estimations were chiefly confined to the outer layers of the roll.

The amount lost in sterilisation varies, probably owing to the exact temperature of the steam and to variations in the method of folding. The amount of cyanogen was taken as a measure of the double cyanide present.

The mean results show that the gauze loses from 60 to 70 per cent. of its double cyanide, the latter being removed as such by the steam. In one case no cyanogen, and only a trace of mercury, could be detected after sterilisation.

It was also noticeable that the gauze invariably lost its colour during the process. Sterilisation of the double cyanide gauze should be by means of chemical solution.

It comes to this, that if a double cyanide gauze be removed from a tin supposed to contain sterilised contents, and if that double cyanide gauze retains any of its original colour, then it can be said to be insufficiently sterilised by the heat employed. One firm guarantees sterility of the double cyanide gauze. The sterilised gauze from this firm retains its colour and correct proportion of salt. The firm in question will not tell me how they do it, so I cannot say whether their methods are dependable or not.

It may be said here with a knowledge of the serious nature of the charge that the sterilisation now being adopted is on the whole of a nature which no bacteriologist would trust in his laboratory experiments, and what freedom there is from micro-organisms in these dressings and towels, aprons and swabs, depends mainly upon the elementary purification they received at the ordinary laundry.

Roughly speaking, I believe that until we can be sure that sterilisation of the skin is attainable, antiseptic dressings and methods are additional safeguards even in cases where the surgeon has to deal with cases which are not "septic." But where the surgeon is dealing with sepsis to begin with, *i.e.*, such a case as an abscess, then there can be no doubt in my mind as to the necessity of the employment of antiseptics.

Iodoform Gauze to have any value ought to contain not less than 10 per cent. of iodoform, and 20 per cent. is to be preferred. Some samples I have examined do not contain 2 per cent. No dressing is so liable to be short of its declared strength in consequence of the use of iodoform in imperfect solution by conscienceless manufacturers. When a packet of this kind is opened, such iodoform as there is looks as if it had been only dusted on to the gauze, and much of it may be lying free in the paper. The smell of an iodoform dressing is of no use whatever as an indication of the amount of active principle it contains; there is little difference in odour between a gauze containing 1 per cent. and one containing 10 per cent.; nor is the colour any indication, as some gauzes are coloured fraudulently with picric acid or some spirit-soluble aniline dye to mask a deficiency in active principle. This form of sophistication is readily detectable as follows: Wash pieces of the gauze with ether in a stoppered bottle, pour off and evaporate the ether, dissolve the residue in water, filter; if the filtrate be yellow, picric acid or dye is present; picric acid tastes bitter; or a deep red picramate of potassium is produced on boiling some of the filtrate for a few seconds with solutions of caustic potash and glucose (0·5 per cent. of each).

Salicylic Gauze and Wool ought to contain 3 to 10 per cent. of salicylic acid. Cheap and inefficient substitutes for alcohol as a solvent of salicylic acid are used with comparative frequency; in that event permeation of the material is impossible. Borax is such a substitute; it cannot be detected by either appearance or smell; the resulting dressing contains only sodium salicylate and boric acid, and is practically useless. Another substitute is ammonium acetate; the resulting dressing contains only ammonium salicylate and free acetic acid: it is not only useless in the presence of fermentation and putrefaction, but the acetic acid that is evolved is a noxious irritant. Any salicylic dressing with even the faintest odour should be rejected.

Carbolic Gauze and Wool are, for antiseptic purposes, trustworthy when freshly prepared, but it should be remembered that carbolic acid is very volatile. The pinkish tinge which is seen sometimes on these dressings is due to the elaboration of rosolic acid, which is distinctly irritating. Similarly irritating is cresylic acid, a product of impure phenol, which produces a brownish tinge. Carbolic dressings exhibiting either of these colours ought to be rejected.

Boric Gauze and Wool can be depended on to contain the active principle, for boric acid is too cheap for substitution, and it occurs in a pure form. The boric acid, however, is very apt to shake out of the material after drying.

Sal Alembroth Gauze and Wool should contain 2 per cent. of ammonium mercuric chloride. The disadvantage of this dressing is the great solubility of the chemical when it is wet, and the irritation it causes when it is liberated.

Bismuth Dressing has been put upon the market with the reputation of preventing the putrefaction of discharges held in its meshes. To test its practicability in this connection I performed the following experiment on several occasions: In a wound to which fæces were gaining access, bismuth gauze and double cyanide gauze were placed side by side; after twelve hours the bismuth gauze was always highly offensive, while the double cyanide gauze remained sweet. In repeating this experiment care must be taken that the cyanide gauze is 3 per cent.

I may mention here that perchloride of mercury tabloids from numerous sources were included in the investigation and found to be up to strength; they ought, none the less, to be made pharmacopœial preparations.

In making a **Choice of Dressings** the following facts have to be borne in mind. Iodoform is not a germicide, it only inhibits the growth of organisms. Iodoform dressings, therefore, must be sterilised before application. The best means of sterilising iodoform dressings is to wring them out of carbolic solution (1 in 20) immediately before use, as they lose half their iodoform value if sterilised by heat. Carbolic dressings are very sound in principle, but in practice one cannot be sure how much of the volatile carbolic acid remains in the dressing. Perchloride of mercury dressings and sal alembroth dressings are similarly sound, but the active principle in each instance is so soluble in serum that it is carried by the serum from the layers near the wound into the outermost layers of the dressing, where it becomes highly concentrated; in other words, it is removed from the part of the dressing where it is most required to that where it is least required. Double cyanide of zinc and mercury is a salt very slightly soluble in serum, therefore quite a considerable amount of discharge must occur before the chemical is removed from the layers in immediate contact with the wound. This double salt inhibits the growth of bacteria, but is not germicidal; notwithstanding the fact that double cyanide dressings require sterilisation before use, the comparative insolubility of the salt makes these dressings the most valuable in use. It will be well to remind the surgeon that there is nothing but the word of the vendor as to the trustworthiness of his goods, and that many a surgeon (and many an institution) who imagines that he is using double cyanide gauze of full strength is living in a fool's paradise. The fact thus baldly stated strengthens the position of those who maintain that sterilised, non-chemicalised dressings are all-sufficient. My conviction, founded on experiment and experience, is that chemicalised dressings are safer, and that our energies should be directed to securing their purity and standardisation.

The value of **wool** in the dressing of wounds is in aiding the gauze to collect discharges, and in securing the application of equable pressure, but wool is not essential.

Lint finds its chief use in hot fomentations, and as a covering for splints. In antiseptics the value of lint depends entirely on the lotion in which it is soaked at the time of its application.

Green protective is used very little now; it is still employed to protect recent skin-grafts. Its use obviates the usually painful removal of dressings from whitlow. The great objection to its use is the fact that it cannot be boiled to secure its disinfection. Tissues adaptable to the same uses, and which can be boiled, are on the market now, and will take the place of green protective. The waterproof property of these oiled silks makes them useful for covering fomentations. Among **mackintoshes** there is a material called *batiste*, which can be boiled. Any material which can be boiled is to be preferred to one which can be cleaned only by scrubbing and other such process.

Drainage Tubes.—In inserting drainage tubes I always wind a little collar of double cyanide gauze round that part of it which remains in contact with the edges of the skin. After many observations made upon tubes with and without these collars I am convinced that it is a precaution which is valuable in keeping the tube, its contents, and deep tissues in contact with it free from infection. No tube should be inserted without a guide in case it should slip beneath the surface and out of sight.

THE SURGEON AND HIS ASSISTANTS.

Before referring to these in detail some remarks are applicable to all.

From the moment the patient begins to inhale the anæsthetic till his consciousness is restored every thought and act of the surgeon and his assistants should be concentrated on the work in hand. Silence from the beginning to the end of the operation is the first essential; the moving of furniture, rattling of instruments, and splashing of water are all disconcerting to a patient in the early stages of anæsthesia. Nothing is so out of place as frivolous or noisy conversation, nor so incompatible with the occasion. No function can be so solemn and impressive as a properly conducted operation.

On one occasion, when I was assisting Lord Lister in King's College Hospital, he performed so brilliant and rapid an operation (lateral lithotomy) that a theatre full of students and visitors cheered. The operator was exceedingly shocked, and turning to the onlookers said, "Gentlemen, gentlemen, remember where you are."

The Surgeon has to pay attention to his hands and arms. In the routine of his work a surgeon ought not to put his hands and fingers into septic cavities more than he can avoid, so that these parts may not be more difficult of sterilisation than need be. The nails ought to be kept short. In preparing to operate the surgeon should wash his hands and arms in soap and water, using a nailbrush to secure thoroughness. The further purification depends on the effect of the various antiseptic solutions on the surgeon's skin. A trustworthy, practical method is as follows: The nails are scrubbed with a nail-brush in Lister's strong mixture, then the nails, hands and arms are scrubbed with a nail-brush in three separate vessels containing perchloride of mercury solution (1 in 2,000). Some surgeons say their skin will not stand solutions of these strengths; rather than use other antiseptics it is better to dilute these solutions to a strength which can be borne. Any solution which gives rise to rough or cracked hands negatives the use for which the antiseptic is intended. After a thorough trial of other antiseptics for the hands, including those that have been recommended from time to time, I have always reverted to those introduced originally by Lord Lister, carbolic acid and perchloride of mercury, as the most practicable and efficient.

With regard to the wearing of gloves, it is best for the surgeon and his patient that gloves should be worn, and no material is so good as rubber. They are easily and efficiently disinfected by boiling; they prevent the introduction of sepsis by the hands, for it is never possible to be sure that sterilisation of the skin has been obtained; they protect the hands of the surgeon in septic cases. The only occasions on which silk or cotton gloves can be of value are during operations where spicules of bone are liable to be encountered and to tear rubber gloves; then the silk or cotton gloves should be drawn over rubber gloves to protect them.

It may be asked why it is necessary to purify the skin of the hands so much if it is going to be covered with rubber gloves. The reply is that a glove may be pricked or torn or cut; if the hand be unpurified a septic surface is at once brought into contact with the wound. Some surgeons slip on their gloves out of sterilised water, others put them on dry after powdering them inside. I have obtained cultures from the inside of gloves so used, but not from the inside of gloves put on out of perchloride of mercury solution (1 in 4,000), so it is safer to use the perchloride solution than the sterilised water or powder.

The surgeon's breath requires consideration. The less he speaks the better, for it is to be remembered that in talking one spits unconsciously. It is possible to conduct most operations in silence, and when it is essential to speak the head should be turned away from the wound. My own assistants are educated to translate different signs in the use of different instruments; with a well-trained assistant I need never speak. It is an additional precaution to wear an efficient mask; those combined with a cap are the best. *Masks* are readily made of gauze; and from experiments of my own I should say that the part of the mask which covers the nose and mouth should consist of at least four layers of gauze or one layer of some material impervious to wet.

To obviate the necessity for a mask I have been trying for four or five years to operate with a sheet of glass (*see* Fig. 3) between my face and the wound. Such a screen is practicable, useful and sound in certain operations, *e.g.*, hernia, breast and appendix cases and varicose veins; on the other hand, the glass gets in the way when a

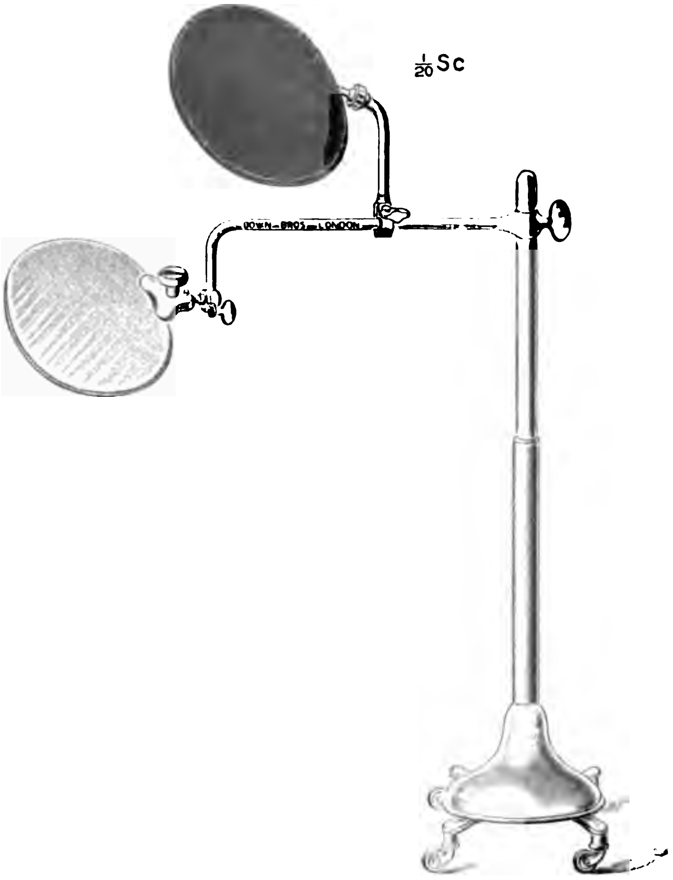

FIG. 3.—The dark shaded part of the apparatus is a diaphragm to cut off the top light and to prevent reflection. It is necessary only where a top light exists, and therefore in ordinary rooms it is unnecessary. Below it is the glass screen, which measures 22 in. × 18 in. It should be placed over the seat of operation, one extended hand's-breadth above it. It is long enough to exclude the breath of the assistant as well as that of the surgeon. The stand is 5 ft. 9 in. high. To avoid reflection it can be placed at any angle. To avoid condensation of air both surfaces may be rubbed over with "lasen." The whole apparatus can be sterilised by carbolic acid.

trephine or chisel and hammer have to be used, and where parts have to be moved about in a wide area, *e.g.*, in amputation at the hip.

The surgeon's apron is best sterilised by steam, at not less than 110° C. under pressure for one hour. We find at King's College Hospital that at that temperature the spores of B. anthracis are killed. By wearing a mackintosh apron underneath the cotton apron, the surgeon's own clothes are protected from blood, discharges, etc. There is no occasion for the surgeon's apron to be soaked with a chemical solution. If a dry sterilised apron is not available, mackintosh scrubbed down with Lister's strong solution answers the purpose, the tapes being soaked in the same solution if tied in front; but they are better to be tied behind out of the way.

The surgeon's assistants' preparations are the same as the surgeon's. The best anæsthetists concentrate their attention on the giving of the anæsthetic, refraining throughout their administration from overlooking the operation or indulging in general conversation. They do nothing and say nothing and think of nothing but that which is necessary for the good of the patient under their care. The anæsthetist should see that the head of the patient is turned as far as practicable from the site of the operation, and he should be on the alert to prevent contamination of the wound in case of the patient coughing or vomiting. Should the surgeon inadvertently touch any unsterilised apparatus used by the anæsthetist, or bring any instrument in contact with such or with the anæsthetist himself, his attention ought to be drawn to the fact at once.

GENERAL METHODS OF PREPARATION.

Directly an operation is determined upon all possible sources of infection should be attended to. If time permit, the teeth should be stopped or stumps extracted, and the gums made free of pyorrhœa. Ulcers of the leg in connection with varicose veins or malignant ulcers should be treated to secure as high a state of freedom from infection as can be attained. Acne in the region of the prospective incision would require attention.

When an operation has to be performed in or near a septic focus the question arises whether the safety of the patient does not demand the use of the appropriate vaccine or serum to induce artificial immunity. This applies especially to operations about the mouth and rectum, and in septic genito-urinary conditions. In circumstances such as these I have attempted to induce a preliminary immunity before operating. Great care was observed to provide against all likely infections; sometimes as many as four micro-organisms were inoculated. In timing the operation the negative phase was avoided; and yet I did not find that the cases did any better than when no serum nor vaccine was used.

The administration of strychnia for a few days preceding an operation, as a preventive of shock, is to be recommended in all cases in which shock is anticipated. This applies specially to the feeble, and to any patient about to undergo amputation of a limb or breast, or an operation on the mouth and tongue, or a prolonged abdominal operation.

Just now there is a vogue among those qualified to judge for administering morphia (gr. ¼ hypodermically) and atropine about fifteen minutes before commencing the anæsthetic. I have not been able to see any advantage from this procedure excepting the induced tranquillity with which the patient faces the operation. It is said, too, that this use of morphia and atropine diminishes the post-anæsthetic vomiting.

If possible I prefer the patient to have an aperient, but not the night before the operation.

The patient ought to be bathed the night before an operation, and immediately before proceeding with the preparation of the area involved in the operation.

The question of shaving is important. Generally speaking, it is more important to shave a part when a wound is septic than when it is aseptic. But all parts should be shaved; it is so difficult to separate blood from hair, especially from long hair. In preparing a female's head care should be taken to remove as little hair as possible.

The part having been shaved, it is well to employ a preliminary lavage with some solvent of grease; the best I know of is acetone. The part needs to be deluged with the acetone and firmly rubbed; it does not suffice to rub the skin with a swab only damped with it. No blistering or other sign of irritation ensues if the acetone is allowed to evaporate, so care should be taken to avoid its retention in folds of skin, as is liable to occur about the scrotum. The next step is to rub well with Lister's strong mixture, which is well borne except by mucous membranes and the skin of the penis and eyelids. The purification should extend over and beyond the area which will be covered by dressing after the operation. Finally, the parts are to be covered with double cyanide gauze, wrung dry out of perchloride of mercury solution (1 in 4,000). Next day, immediately before proceeding with the operation, the use of acetone and strong mixture should be repeated by the surgeon after he has purified his hands and arms and put on his mask and apron, but before he has put on his gloves. Then the area of the operation should be covered with a sterilised towel while the sterilised mackintoshes are being arranged. In arranging the mackintoshes the edge should be inverted for 12 inches under the blankets, or it should not be inverted at all; the former method is perhaps preferable. Unless one or other of these methods be adopted the mackintosh may slip from contact with unpurified parts into those regions which have been purified and render them infected.

The surgeon now puts on his gloves and proceeds to arrange the towels. Not only the area round the site of the operation, but the whole of the patient should be covered with towels. At the seat of operation the edges of the towels should be in the line of the incision, and should come up to the lips of the incision. This is possible in all operations except where a large area of skin has to be removed, as in removal of the breast for cancer. The reasons for covering in all but the line of incision are: (1) to prevent skin that has been purified being exposed; (2) it is so hard to be certain that sterilisation of the skin is complete that the less it is touched by gloved hands, swabs, ligatures, sutures, instruments, etc., which are being introduced into the wound the better; indeed, no instrument, ligature or suture should ever touch the skin; therefore the lips of the wound should be accurately guarded by being covered and kept covered by a gauze containing antiseptic (1 in 4,000 solution perchloride of mercury) and not gauze merely sterilised by heat. The contained antiseptic will inhibit any micro-organism that the skin may have retained, while even retractors are saved by this means from contamination by direct contact with the skin; a gauze not charged with a chemical antiseptic, but only sterilised by heat, has no means of combating micro-organisms in the skin.

Throughout the operation any part of the wound not concerned in the manipulation of the moment should be covered with double cyanide gauze wrung as dry as possible out of perchloride of mercury solution (1 in 4,000).

Except in the case of operations about septic cavities, the air and the doubtful sterilisation of the patient's skin are the only unknown factors in surgical procedures; therefore there appears to me to be no excuse for not adopting the practice just laid down. A wound should be treated with the same protective care as one bestows on a plate culture in bacteriology. In fact a surgical operation is the highest form of bacteriological technique.

When the operation is for the removal of the appendix, Fallopian tube, gall-bladder, testicle, a chain of tuberculous glands, an infective piece of intestine, or other septic tissue, antiseptic gauze should be wrapped round the septic part immediately it becomes accessible enough for the purpose. The gauze employed should contain an antiseptic, for the reason I gave for employing a similar gauze to cover the edges of the skin. The intention is to prevent the infection of other parts of the wound, the instruments, the hands of the surgeon and his assistant. After handling such septic tissue, and before proceeding further with the operation, the surgeon should wash his gloved hands in Lister's strong mixture or change his gloves: the former is a safe proceeding.

There is no need to wash out a wound with antiseptic lotion. If, however, during an operation for the removal of septic tissue infective material is spilt into the wound, such as by the rupture of a tuberculous lymphatic gland, I wash out the wound freely with perchloride of mercury solution (1 in 500), hoping thereby to diminish the dose of the micro-organism. The proof of the value of this technique is that these wounds heal by first intention, and neither general nor local harm ensues from the use of the antiseptic.

At the end of the operation the wound is sewn up with a material which does not absorb serum. For that reason silk is not a suitable suture; either silkworm gut or horsehair should be employed.

Before putting on the dressing the wound should be covered temporarily with antiseptic gauze while the surrounding soiled skin is being cleansed. In this cleansing all washing must be directed away from the wound, not towards it.

The dressing can now be applied. Provided that no drainage tube has been used, and that the wound does not communicate with any septic focus, the dressing should be applied with the idea that it is not going to be removed till it is time to take out the stitches. In all cases the layer of gauze next the skin should be wrung as dry as possible out of perchloride of mercury solution (1 in 4,000). Outside this dry sterilised cyanide gauze may be used; that is to say, gauze which has been allowed to dry in non-infective conditions after its sterilisation in an antiseptic lotion.

Whatever dressing be employed, an attempt should be made to make it as self-supporting as possible, in order to obviate making its application depend entirely on the bandage. Thus in the case of a limb, not only should layers of gauze be placed longitudinally over the wound, but several turns should be made round the limb; by this means the wound is not uncovered should the dressing slip a little. In the case of the trunk, large areas should be covered to allow for the dressing slipping. Nothing is more indicative of inaccurate and slovenly surgical procedure than the sight of a wound uncovered or in contact with a bandage. Such gross errors can be avoided to a great extent by a careful and systematic application of layers of gauze, in which the filling-up of natural hollows with gauze is an important point. After sufficient gauze has been applied, wool on the outside helps to equalise pressure, and acts as an easy elastic support.

If there is bleeding from the wound, *e.g.*, sometimes the stitches bleed, or if there is risk of bleeding, sterilised marine sponges wrung dry out of perchloride of mercury provide an excellent elastic absorbent dressing. A dry sponge is not sufficiently elastic. The sponges should be placed outside the first layers of the gauze.

The bandage should be firmly and easily applied, and is fixed best by being sewn.

When a drainage tube has been used some surgeons apply a piece of separate dressing to that part of the wound to facilitate its removal. It seems to me that it is quite as easy to redress the whole of the wound.

PREPARATION OF SPECIAL REGIONS.

Head.—In the ordinary case of a cut head there is no need to shave more of the scalp than the area around the wound.

In post-aural operations a very limited area of shaving suffices. For a trephining operation, however limited, the whole head should be shaved. To illustrate the technique, I will describe the procedure for trephining. The entire scalp, after being shaved, is purified with acetone, followed by Lister's strong mixture. The forehead and ears are included in the purification. The ears should be plugged with double cyanide gauze to prevent blood running into them. By placing towels between the base of the neck and the pillow, blood is prevented from running down the patient's back. Nothing is so annoying when an operation is over as finding that the patient has to be cleansed of percolated blood; moreover, the necessary cleansing of skin and changing of garments impose an avoidable delay in returning the patient to bed.

After the final cleansing the whole head is covered with a layer of muslin wrung out of perchloride of mercury solution (1 in 4,000), and the incision is made through this material into the skin. When the flap is turned down, it again should be covered with cyanide gauze. Without entering into the detail of the operation, it is worth mentioning here that the bleeding from a scalp incision is very free, so each vessel should be clamped as it is cut, a precaution which keeps the patient clean.

The best bandage to keep a dressing on any part of the head or of the neck is one devised and practised by Lord Lister. The bandage is 2½ inches wide. It is put on as follows: The turns are vertical, horizontal, and oblique. The bandage begins below the chin, it is carried vertically upwards in front of the right ear, over the vertex, and behind the left ear and under the chin: to fix the end of the bandage properly this turn is repeated. The third turn is carried behind the right ear and over in front of the left ear: this turn also should be repeated. The horizontal turns are then made round the neck three or four times; these turns pass into the oblique, which are taken round the head, above the ears and eyes once or twice, ending at the external occipital protuberance, where a pin is inserted. Instead of cutting off the bandage here, carry it over the head in the line of the sagittal suture, pass it under the oblique turns in front and return it upon itself to the vertex, where it is pinned and cut off; if pins be inserted deeply at all points where the turns cross, the dressing cannot be disarranged. The design of this bandage is so good that when properly put on it never moves. It is the only safe bandage for this region, but no turn can be omitted without sacrificing the purpose and stability of the whole bandage.

Mouth, Lips and Cheek.—The beard and moustache ought to be shaved. The same should be done in the case of any extensive operation on the **tongue**.

Neck.—All hair should be shaved. In the case of all operations in this region the ear should be purified and the external meatus plugged with cyanide gauze. This prevents blood from entering the canal.

In purifying the face, the eyebrows, forehead, cheeks and lips stand the application of acetone; but not so the eyelids and vestibule of the nose, which are best purified at the time of the operation by a freshly-made solution of iodine (2 per cent.) in alcohol.

Any operation on a limited area of the scalp, face or neck should be performed through a hole cut in a piece of lint wrung out of perchloride of mercury (1 in 4,000) solution, which covers the rest of the head.

In the case of all intra-buccal, pharyngeal, laryngeal operations, operations on the nose and nasal cavities and on the eye, it is essential to attend to the state of the teeth beforehand. The dressings can be kept applied to the neck only by the bandage described by Lord Lister. If this method of bandaging were more widely practised fewer exposed wounds of the neck would be seen in hospitals, convalescent homes and private practices.

Dressing the Face.—Comparatively heavy dressings can be applied and kept in place by using collodion, if it is applied properly. To apply a thick pad of gauze covered by one layer gummed on by collodion is clumsy and insecure. The following will be found a most effective method: Four thicknesses of gauze are cut to the shape and size of the wound, after having been wrung as dry as possible out of a perchloride of mercury (1 in 4,000) solution; all subsequent layers (of four thicknesses) should be dry and should be of increasing size, like a graduated compress. The final layer should be of one thickness of gauze only, and at least 2 inches wider than the whole dressing. The collodion is to be applied now with a camelhair brush. First the final layer of gauze is fixed to the skin along the edge of the subjacent dressing, then the brush is swept outwards to fix the margin of gauze to the skin. Then paint the whole dressing over with collodion. To remove such a dressing dissolve the collodion with acetone and peel it off quickly. A collodion dressing is not applicable where much hæmorrhage is anticipated. By the skilful application of a collodion dressing, fixing it first on one side of the wound, then carrying it across to the other side, the lips of a comparatively shallow wound may be kept in apposition without the use of stitches. This is often an important consideration in the case of incisions on the face. A collodion dressing is often the best application after the removal of stitches from abdominal incisions. In all situations where the access of crumbs and other food is to be feared, a collodion dressing is valuable.

Breast Operations.—In preparing the skin, particular attention has to be directed to the cleansing of the nipple and of the axilla, which is to be shaved. The area to be included in the cleansing is from the level of the sixth cervical vertebra above to midway between the ensiform cartilage and umbilicus below, and from the other margin of the sternum than that of the side from which the breast is to be removed to midway between the spine and the posterior fold of the axilla, also the shoulder and arm to the elbow. The patient's hair should be covered by an indiarubber cap (used by bathers), which is covered by a towel wrung out of 1 in 4,000 solution of perchloride of mercury. The patient's head ought to be kept turned away from the side of the operation, the area of which it is better to additionally protect from the breath of the patient and that of the anæsthetist by a towel wrung out of perchloride of mercury (1 in 4,000) folded over a metal screen, such as that depicted in the accompanying illustration. The screen is kept erect by a folded towel placed between it and the supra-clavicular fossa (Fig. 4).

The operation for removal of the breast may be accompanied by considerable hæmorrhage, so much trouble in cleansing before applying the dressing, and much time is saved by packing towels between the trunk and the table to prevent the blood percolating between it and the patient. Owing to the necessarily large raw surface made during this operation, particular care is necessary in covering with gauze all that part of the wound which is not concerned in the manipulation of the moment.

In dressing the wound after removal of the breast, layers of gauze should be placed in two directions, alternating first transversely and then longitudinally, and the latter should be taken over the shoulder to secure self-support independently of the bandage. When it has not been possible to bring the edges of the skin incision into apposition, the intervening raw surface should be packed with cyanide gauze to the level of the skin surface before the area of the incision itself is covered with a layer of gauze; by this means a space in which serum can collect is avoided.

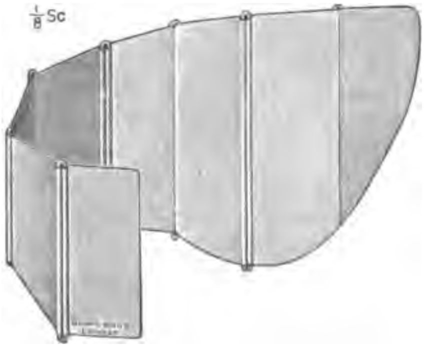

FIG. 4.—A metal shield, portable and sterilisable. It is now in position for an operation on the right breast. It should be covered with a towel wrung out of 1 in 4,000 perchloride of mercury, and kept upright by a folded towel pressed between it and the patient's right shoulder. The anæsthetist and patient's face are on one side of it and the surgeon on the other.

Empyema.—The surgeon has to remember the pressure which exists within the pleural cavity; when the cavity is opened the infective contents can be prevented from squirting over anybody and anything within a considerable distance of the patient by the suspension of a towel wrung out of perchloride of mercury solution (1 in 4,000) over the incision. The final manipulation of the surgeon can take place beneath the towel. The subsequent dressing is kept in position best by means of a many-tailed bandage, with shoulder-straps crossing in front and behind.

Abdomen.—The abdominal walls are to be purified on the lines laid down already in connection with the skin of the chest. The purified area should extend from the breasts above and include Scarpa's triangle of the thighs below; if it is thought that drainage in the loins will be necessary, the back also should be purified. The pubes should be shaved in all cases unless the operation be confined to the upper abdominal region. The umbilicus requires special attention. When the umbilicus is deep it is best to plug it with gauze to prevent it filling with blood or other discharges. When this is done, however, care must be taken that the plug is fixed by a stitch or two so that it does not fall into the peritoneal cavity while it is open.

In the case of operations on the lower abdomen, such as for hernia and appendicitis, the genitals must be cleansed with care. As they will not stand the application of Lister's strong solution, they should be rubbed well with ether soap and then with perchloride of mercury (1 in 2,000) solution. The penis and scrotum should be wrapped in a towel wrung out of perchloride of mercury solution (1 in 4,000). It is quite unnecessary to stitch the penis to the opposite thigh in hernia operations: the procedure only leads to septic wounds in the parts, as they are rarely, if ever, purified beforehand.

When it is thought that a septic discharge will be encountered on opening the abdomen, it is important to plug the vagina and vulva with gauze to obviate the risk of urethritis and vaginitis. This is not at all an uncommon accident, especially in children, when the precaution is not taken.

No incision in the abdominal wall should come nearer the genitals than can be avoided.

After opening the peritoneum the whole thickness of the abdominal wall should be covered round the margins of the wound by the insertion of a sterilised towel wrung out of perchloride of mercury (1 in 4,000) solution, or by gauze, eight thicknesses, similarly treated.

In an operation in which "packing" may be necessary to shut off the normal area from the abnormal I always wring out a packet or two of double cyanide gauze as dry as possible from a 1 in 4,000 solution of perchloride of mercury, unroll them and place them between two layers of towel ready for use.

In gastro-enterostomy, or in any operation involving an opening into the lumen of the bowel or a septic gall-bladder, etc., in which there may be a discharge of infective material from the viscus, it is an invaluable procedure to have a piece of pliable mackintosh among the layers of gauze with which the opening into the abdominal cavity is protected, in order to prevent the septic discharge soaking completely through, which might prevent healing by first intention of the structure forming the abdominal wall. In removing this protective gauze, care should be exercised to prevent infection of the edges of the wound and of the peritoneal cavity by the discharges it contains. This is effected best by rolling up the protecting and infected gauze from its outer margin inwards.

The dressing of any abdominal wound is kept in position best by means of a many-tailed bandage, and a spica, which should be single when the wound is lateral, *e.g.*, hernia or appendix, and double when the incision is in the middle line. Four pins are necessary to fix a single spica securely, and are placed where the turns of the bandage cross each other. I have not known any dressings to slip in a wound thus dressed.

Catheters.—Before passing a catheter the penis should be cleaned with ether soap and perchloride of mercury solution (1 in 4,000), special attention being paid to the external urinary meatus, and towels should be arranged just as for any operation where wounds are made.

Catheters, bougies and sounds should be boiled for twenty minutes in 1 pint of water to which has been added 1 oz. of olive oil; this lubricates as well as sterilises the instrument. If pliable bougies and catheters are to be used, the vessel must allow of their being laid out straight; if this point is attended to they may be boiled frequently without harm to the material. All these instruments should be boiled after as well as before use.

In the case of the female the vulva should be cleansed also with perchloride of mercury (1 in 4,000).

Upper and Lower Limbs.—In cleansing the limbs, the parts which require special attention are the nails, and the transverse folds in the skin of the elbows, knees and heels and toes. The whole limbs should be purified, even for an operation of limited extent; it allows the freest manipulations to be made without the risk of any septic part being touched.

SEPTIC CASES.

The same care in technique is called for in dealing with septic cases as in those where there is no infection; indeed, if the infection is to be limited, there is greater need in these than in non-infectious cases for employing dressings, towels and swabs wrung out of an efficient antiseptic. After handling such a case the surgeon should wash his hands in an antiseptic solution *before* washing in the ordinary basin, which otherwise may become the means of spread of the infection to other cases.

In dressing these cases it is to be remembered that the cure depends on the acquisition of immunity by the patient, and not on the copious application of antiseptics to the septic surfaces.

G. LENTHAL CHEATLE.

SHOCK AND COLLAPSE.

Shock is rather a vague term used to describe a condition which often occurs after severe injuries or operations. It is the chief cause of death after extensive burns and scalds.

It was formerly supposed that the condition was a direct result of the blow or injury. Thus it was particularly common after injuries inflicted in war by cannon balls, and it was thought that the impact of the ball set up the condition ; hence the name "shock."

Thanks, however, to the experimental work of Crile and others during the last six or seven years, the exact physiology of this interesting condition is now known, and we are enabled to deal with it upon a scientific basis and to treat it successfully.

The phenomena of shock are caused by exhaustion of the vasomotor centres in the medulla and spinal cord, as a result of which these centres no longer control the pressure of the blood in the arterial system of the body, and the pressure in different parts of the arterial system becomes dependent upon the force of gravity and the pumping action of the heart. As a matter of fact the blood pressure in the arteries, which in a normal individual is equal to about 130 millimètres of Hg, falls in an extreme case of shock to about 40 or 50 millimètres of Hg, or even lower. Such a condition of the blood pressure is incompatible with life for more than a very short period, as the circulation in the brain cannot be adequately maintained with so low a pressure.

The direct cause of this great fall in blood pressure is dilatation of all the arterial system (owing to the lack of control by the vasomotor centres which normally keep the vessels contracted) and collection of the blood in the large splanchnic veins in the abdomen.

Since it is impossible to treat shock intelligently unless one understands the nature of the condition, it will not, I think, be out of place if we briefly describe, from a physiological point of view, the course of events in a case of severe surgical shock. As the result of repeated severe traumatic stimuli reaching the brain from the injured part of the body the vasomotor centres controlling the blood pressure become exhausted and the blood pressure tends to fall. At first this is partly compensated for by increased frequency in the action of the heart, hence the fast pulse seen in shock. Soon a time arrives, however, when in spite of the increased frequency in the heart's action the blood pressure falls below the normal level. Directly this occurs the circulation becomes partially inefficient, and not only will the circulation in the brain be impaired, but the blood itself will not be properly oxygenated, owing to the pressure not being maintained in the lungs. This naturally affects the vasomotor centres and completes their breakdown, with the result that the blood collects in the dilated vessels throughout the body and especially in the abdominal vessels, while the brain becomes anæmic from the inadequate amount of blood which reaches it.

Owing to the failure of the circulation the temperature of the body falls, and the respiration becomes feeble owing to secondary exhaustion of the respiratory centres. As a secondary cause of the fall in blood pressure the specific gravity of the blood is lowered owing to transudation of fluid from the tissue into the blood stream. This may be looked upon as a protective mechanism, and it would seem reasonable to conclude that transfusion is the logical treatment.

The brain cells controlling the blood pressure become unable to perform their allotted function owing to their stored-up energy (or food) being exhausted from their being overworked. They will, however, recover, if they are allowed to rest and if in the meantime the circulation can be maintained at a level compatible with life.

Collapse is a condition closely analogous to shock; the symptoms are identical, but there is an important physiological difference, and it is essential that these two conditions, shock and collapse, should be distinguished from one another, as they require different treatment.

Collapse, like shock, is a condition resulting from a great fall in blood pressure, but instead of the vasomotor centres being exhausted, they are temporarily paralysed owing to some sudden violent stimulus, such, for instance, as an electric shock or a blow in the splanchnic area. Collapse is also produced by a sudden and large loss of blood; in this case the centres are unable to maintain an adequate blood pressure owing to a loss of circulating fluid.

It will be at once obvious that there is an important difference, as in collapse the centres are only temporarily embarrassed and can immediately restore and maintain the blood pressure if proper treatment is instituted, while in shock, owing to their being exhausted, time is necessary to enable them to recover.

Before proceeding to discuss the treatment of shock, it is necessary to describe means by which it may be prevented.

THE PREVENTION OF SHOCK.

Shock is a condition to which the axiom "prevention is better than cure" particularly applies. It is a condition which may easily be prevented, and with proper care can be eliminated from the field of operative surgery even more certainly than sepsis.

The prevention of shock requires the study of details and a knowledge of the factors at work.

Preparation of the Patient.—Starvation and purgation of the patient prior to operation predispose to shock, and should be avoided as far as possible. The period of starvation just prior to operation should be made as short as possible, and in the case of young children should be dispensed with altogether. The same also applies to elderly persons.

Purgation is often overdone and, with the exception of intestinal cases, should not be carried out when severe operations are going to be performed.

The better physical state the patient is in prior to operation the less danger will there be of shock.

The mental condition of the patient is also important, and a small dose of morphia given overnight and repeated in the morning before operation will do much to prevent shock from this cause. Care should also be taken to avoid frightening the patient by excessive preparation and by allowing him to see or hear the preparations made in the operating room. It is also as well not to leave him alone between the time he wakes up and the time the operation is performed. All these little details count for much in preventing mental disturbance before operation.

Position during Operation.—The best position is the Trendelenburg position, as it allows gravity to assist in maintaining the blood pressure in the essential parts of the circulation, and does much to prevent the onset of shock. It should be used much more than it is, as at present it is seldom used except in abdominal cases. Whenever possible it should be utilised for severe and prolonged operations.

When this position has been used the abdomen should always be firmly bandaged *before* lowering the table, even though no abdominal wound has been made.

The question of anæsthesia in relation to shock has been dealt with under the head of Anæsthetics, and the reader is referred to that section (Vol. III.).

Morphia.—The administration of morphia just before the operation is of undoubted value in preventing shock. It acts by cutting off some of the afferent sensory impulses passing to the brain and vasomotor centres from the field of operation.

Warmth.—Keeping the patient warm during the progress of a long operation is most important, and with this end in view the patient should be so clothed that undue exposure of the skin will not be necessary. The table should be warmed as well as the air of the operating room. The wound should be kept covered with warm towels or flat swabs, which should be frequently changed.

Technique of Operation.—Any operation necessarily involves traumatism and tends to the production of shock, but much depends upon the extent and nature of the trauma as regards its shock-producing power. If the surgeon avoids that class of trauma which most tends to the production of shock, much can be done to prevent it. Cutting with a sharp knife causes the minimum of shock, while tearing of tissues causes the maximum. Pulling or dragging upon intestine is very liable to produce shock. Trauma in certain areas is also more productive of shock than in others; thus in the hands more than in the arms, the rectum, and genital organs; in the abdomen in the neighbourhood of the diaphragm more than in the pelvic region. Time is also an important factor. That surgeon who performs the operation most quickly and with the least handling and bruising of the tissues, and who cuts and does not tear, will have the least fear of shock occurring as the result of his operations.

Subcutaneous infusion of saline solution during prolonged operations is now often employed to prevent shock and has proved of great value.

TREATMENT OF SHOCK.

It must be remembered that shock is a condition resulting from exhaustion of the vasomotor centres in the brain, and that the brain cells involved show demonstrable morphological changes as the result of the trauma causing shock, no matter at what part of the body the trauma occurs. It is obvious that there are no means at present at our disposal by which we can restore these brain cells to their normal condition, and, therefore, we cannot treat shock directly. These brain cells, however, will recover and return to their normal condition provided they have rest and provided that the circulation of blood to the brain is maintained. If, therefore, we can maintain an efficient circulation of blood to the vital centres for a long enough period, recovery is almost certain.

It is most important, therefore, to bear in mind that our object in treating shock is to maintain an efficient circulation until such time as the vasomotor centres have recovered, and at the same time to secure rest to the brain during that period.

It is at once obvious that *the use of stimulants of any sort is absolutely contra-indicated*, and that no more certain means of destroying any chance of recovery could be devised than the administration of strychnine.

It is necessary to remember, in the first place, that the patient is in a condition, as already explained, in which gravity will have a marked effect for good or ill upon his circulation. If he has to be moved, therefore, this should be done as gently as possible, and in such a way that his head is kept at a lower level than his abdomen. Absolute quiet should be secured as far as possible, and the patient should not be moved about more than is absolutely necessary. An injection of morphia should be administered. When the patient has been placed in bed, the foot of the bed should be raised at least 3 feet, so as to place his abdomen on a higher level than his head and thorax. The ordinary blocks which are used in most hospitals are only 6 inches to a foot high, and do not raise the bed sufficiently to be of any use; two chairs are much better. This position should be maintained until all symptoms of shock have completely passed off.

Bandaging the abdomen tightly is a useful means of raising the blood pressure, and can be conveniently carried out by the application of a many-tailed bandage. It must not, however, be applied in such a way as to embarrass the movements of the chest. The respiration is feeble and it is most important that the thoracic movements should not be restricted. For this reason heavy bedclothes, if necessary, must be supported on a cradle. In the case of young children recovery or death may easily depend upon the presence of a heavy blanket pressing upon the chest.

Bandaging the extremities is also useful in some cases and should be done by bandaging each limb towards the trunk with a flannel or Domet bandage.

Warmth is very important, as the patient's body temperature is considerably lowered. The body should be well protected against loss of heat by warm blankets and hot water bottles. The greatest care, however, must be taken to see that the nurse's enthusiasm to warm the patient does not result in a burn. Patients suffering from shock get burnt with astonishing ease and the only safe plan is to leave orders that the hot bottles are all to be moved into fresh positions every five or ten minutes.

Infusion of Normal Saline.—By increasing the total quantity of fluid in the circulation the introduction of normal saline into the body tends to raise the lowered blood pressure and to aid the recovery of the exhausted vasomotor centres. It has been proved by experiment that the blood pressure can always be raised by direct intravenous infusion, but that the effect is only temporary in cases of true shock. It is necessary, therefore, to repeat the infusion at regular intervals or to give it continuously until such time as the exhausted centres have commenced to recover.

It is now known that very large quantities of normal saline can be allowed to flow into the circulation without harm and that better results are obtained by repeated or continuous infusion than by one large infusion.

The value of infusion can be much enhanced by adding adrenine in suitable quantities to the saline solution. This drug acts directly upon the peripheral arterioles and causes a great increase in the blood pressure without acting upon the nerve centres. The drug must, however, be used with caution or harm may ensue. It will be referred to again in detail.

There are several different ways of introducing fluid into the circulation, and it is necessary to choose the most suitable for the particular case.

These will be described in detail. The fluid used is the same in all cases and should be a solution as nearly as possible resembling normal blood serum. In cases of emergency, however, plain salt and water may be used without serious risk, but rigors and other disturbances are occasionally seen unless physiological solutions are used.

The following is a simple solution which very closely resembles normal serum: ℞. Sodii Chloridi, 0·9; Potassii Chloratis, 0·03; Calcii Chloridi, 0·01; Aquae, 100. Messrs. Burroughs, Wellcome & Co. also supply very convenient "soloids" which, when dissolved in water, give a physiological solution ("Soloid" Sal. Comp.).

In all cases the solution should be sterilised by boiling and then cooled to a temperature of 100° F. When, however, the fluid has to run slowly through a considerable length of rubber tube, the temperature must be higher to allow for cooling from this source.

For an emergency one may roughly estimate this temperature by putting one's fingers into the solution. It should be just possible to comfortably bear the temperature.

An emergency solution may be made by adding a teaspoonful of common salt to each pint of water. Adrenine should only be added to solutions intended to be introduced directly into the veins; it is quite useless to add it to solutions which are introduced per rectum or subcutaneously.

Rectal Infusion.—This method is easily carried out and is very useful in cases of slight or early shock; it is not of much use in serious cases.

A rubber catheter (about No. 6) should be passed into the rectum and to this should be attached the rubber tube from an irrigator containing warm saline solution at a temperature rather above 110° F. to allow for cooling in the tube. The base of the irrigator must not be raised more than 1 foot above the level of the patient's rectum or the fluid will run in too fast, and will not be retained.

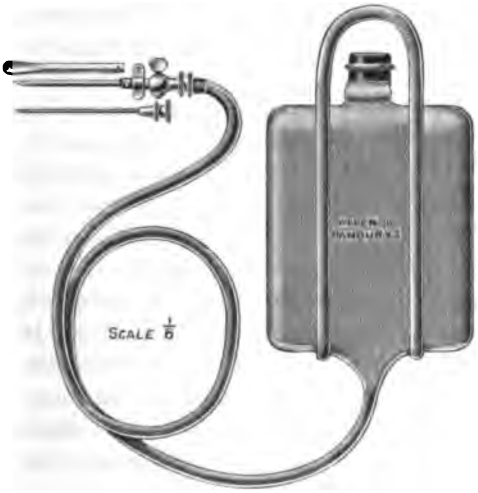

FIG. 1.—Lane's Continuous Subcutaneous Infusion Apparatus.

The temperature of the fluid in the irrigator must be maintained either by the addition of boiling water in suitable quantities or by means of a jacket. The fluid should be allowed to run in continuously until all symptoms of shock have passed off. As much as 20 to 25 pints can be introduced in this way (*see also* Proctoclysis).

Subcutaneous Infusion.—This is suitable in all cases when shock is not very severe, and may then be usefully employed to supplement intravenous infusion. It is now frequently employed during severe operations as a preventative of shock, a plan first suggested by Mr. Arbuthnot Lane. It is performed in the same way as rectal infusion, except that the tubing is attached to a hollow needle (the needle of an exploring syringe will do) passed under the skin of the breast or loin.

The most convenient apparatus is that devised by Mr. Lane, which consists of an indiarubber bottle containing the solution and the necessary needle and tubing (*see* illustration, Fig. 1). The solution in the bottle can be kept warm by placing a hot water bottle beneath it.

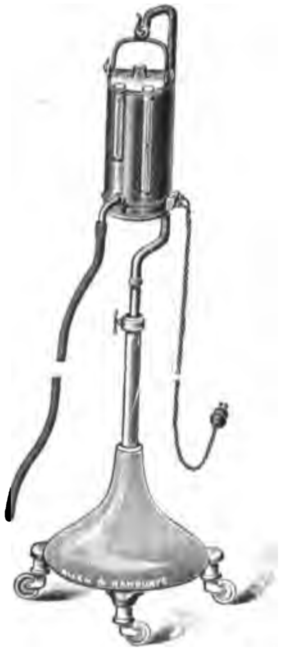

Fig. 2.—Paterson's Electric-heated Infusion Apparatus.

The receiver should not be raised more than 2 feet and a watch must be kept to see that the skin is not unduly distended by a too rapid flow of the solution.

As in the last case, infusion should be continuous ; the needle being moved to a fresh place after about 4 or 5 pints hâve been introduced.

If severe pain occurs after this method of infusion has been used it means that the solution has been run in too quickly or that it was too hot.

Intravenous Infusion.—This method is the one which should be used in serious cases of shock when the blood pressure is very low or in serious cases of collapse when the pulse is imperceptible. The methods previously described are only applicable in cases where there is still a partially efficient circulation in the subcutaneous tissues. Intravenous infusion, on the other hand, is applicable in all cases and may be used as a means of restoring the blood pressure in persons apparently drowned or dead from an overdose of chloroform.

It is necessary to find a large vein and to introduce a cannula into it. The usual method is to tie a bandage round the patient's arm, between the elbow and shoulder, tightly enough to constrict the veins, but not the main artery. This will make the median basilic vein in the bend of the elbow become quite prominent ; if not, a little massage of the forearm will probably make it so. When the vein has been located, a sharp hollow needle is thrust into it through the skin in a direction towards the heart. Or if this proves difficult, and it requires some little dexterity to avoid transfixing the vein with the needle, the vein is exposed by an incision about ½ inch long immediately over it. A double ligature is then passed under the vein on an aneurysm needle. The lower ligature is then tied so as to shut off the blood from below; the ends of this ligature are not cut off, but are used to pull the vein upwards and downwards; this puts it on the stretch and steadies it. A small glass cannula attached to a length of rubber tubing being at hand, and filled with saline solution, a cut is next made into the vein above the lower ligature, and the end of the cannula is quickly slipped into the vein in a direction towards the heart.

The upper of the two ligatures is then tied on to the cannula so as to retain it within the vein. A piece of sterilised dressing is next placed over the cannula and wound. The bandage round the arm is removed and the infusion fluid allowed to flow into the vein. The apparatus advised for subcutaneous infusion may be used or a glass funnel can be attached to the rubber tubing, and the saline solution poured into it from a jug. In any case the funnel or receiver must not be raised more than about 2 feet or the flow will be too fast; a rapid flow is undesirable, except in cases of resuscitation.

If the fluid will not enter the vein this may be due to: (1) The bandage not having been removed from the arm; (2) the cannula having been put into the sheath of the vein and not into its lumen or having been thrust right through the vein; (3) a clot having formed in the cannula from blood being allowed to flow back into it before turning on the flow of saline.

Infusion to be effective in a case of shock must be carried out continuously until the patient is well on the way to recovery and is out of danger.

It sometimes happens that the median basilic vein is too small or too much collapsed to allow of a cannula being placed in it. Also in children this vein is often not large enough. In serious cases some other vein must then be found. The internal saphena vein, about 2 inches below its junction with the femoral vein, is generally large enough to be used and should not be difficult to find. On no account, however, should the femoral vein itself be used for intravenous infusion, as serious trouble with the leg will follow if the patient recovers; but one of the jugular veins can be safely used in an emergency.

Intra-peritoneal Infusion.—Another method of infusion which is useful during abdominal operations is to pour several pints of normal saline solution into the peritoneal cavity before closing the wound.

Transfusion of Human Blood.—This method involves the making of an arterio-venous anastomosis between the vessels of the patient and the donor of the blood. The obvious difficulty of having at hand a person willing to allow himself to be bled, and the risk involved, not to speak of the fact that an expert operator is a necessity, make this method unpractical except in very special circumstances. It has, however, been used very successfully in America by Dr. Crile and others. It is far more effective than any form of saline infusion.

While infusion of normal saline into the veins or tissues of the patient will do much to maintain the blood pressure during recovery from shock, it is not sufficient in severe cases to maintain the pressure at the normal level, and it is necessary to make use of some drug which will cause contraction of the vessel walls, and so aid in maintaining the blood pressure. The drugs which will do this are adrenine and the extract of the infundibular lobe of the pituitary gland.

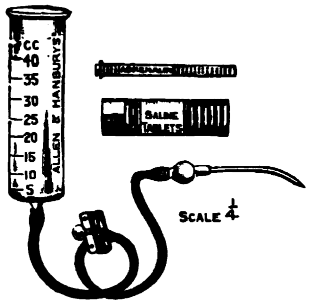

FIG. 3. The author's Apparatus for intravenous infusion with Adrenine.

Treatment by Drugs.—*Adrenine.*—This drug will raise the blood pressure to or above the normal level in all conditions of shock, and it does so by acting directly upon the vessel walls and without the intermediary of the nervous system.

The two drawbacks to the use of this drug are, that its action is transitory, lasting only a few minutes (two or three as a rule), and that, in order for it to act at all, it must be put directly into the veins.

The only way in which it can be effectively used is by adding a small quantity of the drug to the fluid used for *intravenous* infusion. *It is absolutely useless to add it to fluid used for subcutaneous or rectal infusion, or to inject it under the skin.* It should be added to the infusion fluid in a proportion of 1 to 30,000. It must not be used in stronger solution or the blood pressure will be raised to such a degree as to risk dilating the left ventricle of the heart.

The dilute solution should be run into the vein until the blood pressure is restored to about the normal level (130 millimètres of Hg) as indicated by a sphygmomanometer, or, if this is unobtainable, by noting that the patient has a good radial pulse. When this end is attained the fluid should only be allowed to flow in very slowly, say two or three drops per minute, the rate being proportioned so as to keep the blood pressure as far as possible at a steady level in the neighbourhood of the normal.

By using adrenine in this way we have absolute command over the blood pressure and can maintain it until such time as the vasomotor centres recover. It is somewhat troublesome and requires some care to carry out properly, but on the other hand it will often save life when nothing else will.

Pituitary Extract.—This is an extract from the infundibular lobe of the pituitary gland, and is now obtainable commercially. Its action is similar to that of adrenine, although as used at present the drug is not so powerful. It has the material advantage over adrenine, that its effects last from half an hour to an hour. The blood pressure is raised and maintained at a high level, without repeating the dose, for this period. Like adrenine, however, it must be injected into a vein, for although, unlike adrenine, it has some action when injected subcutaneously, this is very uncertain.

It can be administered in fairly large doses with safety, but repeated doses have less effect than the original dose, and if repeated more than four or five times it has no effect at all on the circulation. This drug promises to be of very great value in the treatment of shock, though at present it is only just beginning to be used.

Other drugs which have been used are ergot and digitalis, but they are of little, if any, use.

Before leaving the subject of drugs it is necessary to point out that they must be used intelligently. It is both useless and silly to inject a dose of either adrenine, pituitary extract, or any other drug with a hypodermic syringe under the skin of a patient's arm when that patient is suffering from severe shock and is almost pulseless, and to expect it to do any good. It might as well be squirted on to the floor, as it can do no possible good. It must be put into a vein, and, further, if the circulation in the arm or leg into which it is injected has practically stopped, some means must be taken to get it into the main vessels. Hence the use of intravenous infusion as an aid to the use of these drugs.

Feeding.—Patients suffering from shock are suffering from a lack of available energy in the tissues, especially the brain, and it is, therefore, important to give them some easily assimilated food as soon as possible. The digestive functions being in abeyance from the lowered pressure, ordinary feeding is useless, even if possible, in severe cases. Subcutaneous feeding is, however, possible, and should be made use of.

Most patients will have sufficient food stored up in their own tissues to enable them to recover, providing that it is available. If the tissues are dry from lack of fluid this source of supply is not available, and it is, therefore, very important to see that the patient is well supplied with water. For this reason alone some form of infusion of water is most useful.

Summary of the Treatment in a Case of Shock: (1) Move the patient as little and as gently as possible; keep him absolutely quiet and in a shaded light; (2) give an injection of morphia; (3) raise the foot of the bed at least 3 feet and bandage the abdomen, and, if necessary, the limbs; (4) keep him warm with hot bottles and a warm room, but with good ventilation, and with no heavy bedclothes over the thorax; give oxygen if available; (5) give continuous subcutaneous or intravenous infusion of physiological salt solution; (6) administer a dose of pituitary infundibular extract by injection into a vein or by putting it in the fluid used for infusion; (7) administer nourishment as soon as possible or give subcutaneous feeding.

TREATMENT OF COLLAPSE.

Collapse differs from shock in that the vasomotor centres are not exhausted, but only momentarily unable to hold up the blood pressure. Therefore stimulants are permissible. The first indication, however, is to restore the blood pressure to its proper level, by placing the patient in the head-down position, and by pressing upon the abdomen or tightly bandaging it. If the collapse is severe or persists in spite of these measures, intravenous infusion should be performed at once and continued until the symptoms have passed off. Or an intravenous injection of pituitary infundibular extract may be given.

Cases of collapse, in which this treatment is indicated, are such as those seen, after a blow in the splanchnic area or testicles, when a patient suddenly gets pulseless while under an anæsthetic, in cocaine poisoning, after the too rapid removal of ascitic fluid, and in similar conditions. The collapse following a severe hæmorrhage is somewhat different, as in this case the vasomotor centres are not paralysed, but there is a lack of circulating fluid in the blood-vessels. The obvious indication is to supply this lack of fluid by immediate infusion either intravenously or subcutaneously and to keep the patient in the head-down position. The blood pressure once restored will remain raised, and no further fall in pressure is liable to occur without a fresh hæmorrhage. Adrenine may also be used, but is often contra-indicated on account of its liability to cause a fresh hæmorrhage.

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TUMOURS.

I. TUMOURS NOT INCLUDED UNDER REGIONAL SECTIONS.

Lipomata.—Local; diffuse.

Sebaceous Cysts.—Sebaceous horns; sebaceous adenomata.

Dermoid Cysts.

Implantation Cysts.

Fibromata.—Neuro-fibromata; amputation fibromata; molluscum fibrosum; desmoid; cheloid; epulis.

Rodent Ulcer.

Lipomata arise most commonly in the subcutaneous tissues of the trunk. They are also found in the sub-peritoneal fatty tissue (retro-peritoneal lipoma), in the fat of the sub-conjunctival tissue, and in the submucous tissue of the alimentary tract, where they may form polypoid masses which project into and occasionally obstruct the lumen of the gut. In the joints the sub-synovial fat is sometimes the seat of a branched lipoma which may completely fill the synovial cavity (lipoma arborescens).

Both the perineurium and the periosteum at times give origin to fatty tumours. Some of those which grow in early life are of congenital origin and may attain great size. Fatty masses many pounds in weight have also been found growing in the intermuscular planes of the limbs.

Usually single, lipomata may be multiple. There is a class of multiple lipomata in which small tumours, rarely larger than a shelled almond, are studded about the arms and legs. They are said to grow from minute filaments of the sympathetic nerves and may occasion great pain.

Even when quite small, lipomata should be removed; for they tend slowly to increase in size, they may become painful, and they may, owing to mechanical irritation, undergo inflammation and possibly suppuration. Occasionally they become pendulous and form elongated tumours of considerable size. A rare change is calcification of the fibrous septa of the tumour.

The excision of a small subcutaneous fatty mass is an easy matter. When the lipoma is of considerable size it simplifies matters to cut it completely across and then enucleate the two halves, care being taken that no part of the tumour is left behind.

When the resulting cavity is of large size, a drainage tube should be left in for twenty-four hours to obviate the formation of a hæmatoma. On the face and in other exposed positions a slightly curved incision will be found to give a very satisfactory scar, particularly when so planned that it corresponds with the natural lines of the skin. When dealing with large lipomata arising in the intermuscular planes or in connection with the periosteum or nerve sheaths, great care is necessary to avoid injury to vessels and nerves. A long incision is absolutely essential, and it may be necessary to divide the tumour into several portions in order to preserve the integrity of important structures. Slender finger-like processes of fat will often be discovered insinuating themselves between the muscles along the line of least resistance, and the exercise of undue traction may result in the detachment of one of these outrunners. If overlooked it will inevitably lead to the formation of another tumour. Retro-peritoneal lipomata are not often diagnosed. They produce large yielding abdominal tumours which require long incisions and prolonged dissection for their removal. Interesting varieties of this type of lipoma are furnished by the small fatty masses which push their way through deficiencies in the upper part of the linea alba (fatty hernia of the linea alba). The pain they cause frequently calls for their removal, and it is important to remember that a minute diverticulum of peritoneum is often contained in the centre of each little fatty protrusion. Similarly the small ovoid masses of fat found extruding from the inguinal and femoral canals may also contain finger-like pouches of peritoneum, the non-recognition of which may give rise to trouble. When operating on these fatty hernias it is well to dissect carefully through the fat in order to ascertain the presence or absence of a process of peritoneum within it. If peritoneum is present it should be accurately transfixed and ligatured before the tumour is cut away.

A lipoma in the mid-line of the back may be the only indication of a spina bifida occulta. Or such a lipoma, perhaps pedunculated and of large size, may conceal in its interior a meningocele. If this meningocele be of the type (meningo-myelocele) in which the nerves of the cauda equina are spread over its posterior aspect, the complete removal of the supposed lipoma will have the most disastrous consequences.

Diffuse lipomata are ill-defined masses of fatty tissue which usually occur about the neck and shoulders, less commonly on the trunk. They can hardly lay claim to the designation of tumours, for they are of the nature of overgrowths of subcutaneous fat rather than new formations. The lipomatosis may be symmetrical and the masses may reach such prodigious size that very serious disability and deformity result. A moderate degree of the condition is not uncommon and is frequently associated with general obesity; it may happen, however, that diffuse lipomata are found in those who are otherwise emaciated. The formation of somewhat similar masses of fat in the clavicular regions of cretins suggests a possible connection between the condition of diffuse lipomatosis and athyroidism. Mr. Shattock has very fully investigated the whole question of lipomatosis and applies the term "paracretinoid" to certain types of local and general obesity.

Treatment of the condition by the administration of thyroid extract has had a certain measure of success. Five grains of the extract should be given daily; within a week the dose should be increased to 10 gr., and if no ill effect follow, 15 gr. may be given. Intolerance is indicated by quickened pulse rate, palpitation and irregular action of the heart. These symptoms may be to a large extent obviated by taking the daily dose in one amount just before retiring to bed. Long continued treatment may be necessary, but moderately good results are often obtained. The improvement is not always permanent and repeated courses of thyroid extract may be required.

Operative measures can do little for diffuse lipomata, although the removal of a particularly prominent or unsightly mass is sometimes worth attempting.

Sebaceous Cysts are found wherever sebaceous glands occur and are frequently present in considerable numbers.

Their removal is usually an extremely simple matter; a small incision is made through the overlying skin and the cyst is shelled out. When there have been repeated attacks of inflammation a little difficulty may be experienced in freeing the cyst wall from its surroundings.

In the case of large tumours the overlying skin becomes considerably stretched and thinned, and on the scalp pressure atrophy of the hair bulbs often follows, with the result that the summit of the cyst is bald. In these circumstances it is often useful to enclose an ellipse of skin between two curved incisions, and to dissect out this area with the cyst attached. The edges of the wound then come together without redundancy, and a bald patch is avoided.

Infiltration anæsthesia with 1 per cent. eucaine solution is all that is necessary for these simple operations. Care must of course be taken that the fluid is injected along the lines of the projected incision and not *into* the cyst. If in addition a few drops of solution be injected directly under the cyst, subsequent dissection will be absolutely painless. It is unnecessary to disfigure the head by shaving the operation area. The hair and scalp may be sterilised by washing with ether soap, followed by the application of tinct. iodi (B.P.), half an hour before operation.

When left to themselves sebaceous cysts undergo various vicissitudes; their common fate particularly when subjected to mechanical irritation is inflammation and suppuration.

When suppuration is established, the wisest plan is to make a small incision and evacuate the pus and sebum. After the infection has quieted down the cyst wall is excised.

Excision during suppuration is to be deprecated as infection of the wound is certain to occur and cause delayed healing and an unsightly scar; moreover, the cyst wall is so soft and friable that a portion is extremely likely to be left behind. Should this occur, continued discharge or a recrudescence of the cyst will ensue.

A suppurating sebaceous cyst left to nature bursts, discharges its contents, and perhaps undergoes spontaneous cure owing to sloughing of the cyst wall. More often however the cyst fills up again and once more suppurates.

Occasionally a suppurating cyst gives rise to a large mass of fungating granulation tissue which has been mistaken for a malignant growth. Antiseptic compresses should be applied until the swelling is fairly clean; it is then excised.

Sebaceous horns are curiosities that result from the gradual extrusion of sebum from a sebaceous cyst. The surface layers dry and become hard, while fresh sebum is continually being formed underneath, so that gradually there is produced a horn-like structure which may attain the most extraordinary dimensions. Such a horn may be detached by a forcible jerk, but the sebaceous cyst from which it originated should then be treated by excision.

Sebaceous Adenomata are solid tumours of small size which arise from sebaceous glands. They are nearly always situated on the scalp or face, and are often indistinguishable from sebaceous cysts. The treatment is identical.

Dermoid Cysts.—The formation of a dermoid cyst is possible wherever cutaneous surfaces have coalesced during the process of development. The middle line of the body, including both head and trunk, and the lines of the primitive facial clefts are therefore the positions in which these cysts may occur.

The commonest site for a dermoid is at the outer end of the palpebral fissure; but they are also quite common at the inner end of this fissure and in the middle line of the scalp. They have occasionally been noted over the sternum or even within the mediastinum. In the latter situation a dermoid cyst has been known to acquire communication with a bronchus and give rise to expectoration of pultaceous material containing long strands of hair. A dermoid cyst in the middle line of the back has been mistaken for a meningocele and vice versâ. In the sacro-coccygeal region a special variety of dermoid originating in the hind-gut sometimes is met with.

Owing to the manner in which dermoids of the scalp are developed a communication with the meninges not infrequently exists through an opening in the bony cranium. In fact, dermoid cysts actually within the cranial cavity and in intimate connection with the brain itself are from time to time reported.

Branchial dermoids arise in the primitive branchial clefts. They give rise to rounded cystic tumours deeply situated in the neck which require prolonged and difficult dissection for their removal.

Dermoid cysts grow slowly, but ultimately attain a considerable size, when they often suppurate. They should be treated by excision, the technique being precisely the same as that employed for sebaceous cysts.

As in the case of sebaceous cysts, nothing less than complete excision of the sac of a dermoid should be attempted. Incomplete operations are followed by re-formation of the cyst.

The writer has had the opportunity of investigating two remarkable cases in which ovarian dermoids had become the seat of squamous cell carcinoma. These are of particular interest in connection with the possibility of a similar occurrence in dermoid cysts of other parts. This has never been recorded, except in the case of branchial cysts (branchiogenous carcinoma), and these cases are open to considerable doubt. Some are examples of carcinoma arising in aberrant thyroids, and in other instances the growth is secondary to a small primary carcinoma hidden away in one of the recesses of the nose or naso-pharynx. In one remarkable case of this kind a small squamous cell carcinoma was found post-mortem at the bottom of the external auditory meatus.

Nothing short of the most scrupulous post-mortem demonstration of the absence of a primary growth can be accepted as conclusive evidence of the occurrence of branchiogenous carcinoma.

Implantation Cysts result from the implantation of a portion of the epidermis in the deeper tissues. It is probable, indeed it is certain, that not all such detached fragments survive their enforced journey; hence implantation cysts are rare tumours.

They are found in those parts of the body exposed to wounds by pointed instruments; the hand is the most common situation. In cattle the axilla is a common place, as the result of wounds made by the sharp iron tip of the drovers' goad.

They have been seen in the anterior chamber of the eye, or in the cornea itself, owing to small fragments of epithelium or perhaps a hair having been carried in during operations on the cornea or by accidental perforating wounds of the eye.

When occurring in the subcutaneous tissues these cysts are quickly and permanently cured by simple excision, carried out in exactly the same manner as in the case of sebaceous and dermoid cysts.

Of very special interest are certain cystic structures occasionally found in the abdominal scar after operations on the female pelvic organs. There is every reason to suppose that these cysts result from the accidental grafting of a small portion of ovarian adenoma or similar tissue during the delivery of the tumour from the wound.

Of like nature are the innumerable little cysts which grow from the peritoneum, when a papilliferous cyst of the ovary has burst its capsule. It is said that these small secondary cysts sometimes disappear spontaneously after the removal of the primary growth.

The cognate subject of the implantation of cancer cells, artificially detached from the parent tumour and giving rise to metastatic growth, will be referred to later under Cancer Infection.

Fibromata are new growths composed of adult fibrous tissue, and are met with in a multiplicity of forms in the skin and subcutaneous tissues, and in the submucous tissues of the mouth, pharynx, intestinal tract, and even bladder.

Subcutaneous fibromata are single or multiple. When the latter they are usually connected with the sensory nerves and are termed neuro-fibromata. These may occur on any of the peripheral nerves, even on the spinal roots within the neural canal. In such cases laminectomy may become necessary in order to relieve pressure on the spinal cord or cauda equina. When excising fibromata from large nerves which are spread out over the tumour, an incision should be made parallel with the nerve fibres, and gradually deepened until the tumour is reached, when it is carefully shelled out. If separation be impossible, resection of the tumour and immediate suture of the nerve should be attempted.

There is another large class of fibromata which are intimately connected with the terminal twigs of the cutaneous nerves. These are the soft fibromata of the skin (fibromata molluscа), which are often single, but may be very numerous indeed, the resulting condition being then known as *von Recklinghausen's disease*. This disease is characterised by the presence of numerous soft pendulous tumours of the skin which give rise to no symptoms unless they become inflamed. It is quite common to see cases in which some dozens or scores of these bodies are present. They rarely require treatment unless their position or excessive size occasions discomfort. In that case the pedicle is transfixed with a straight needle armed with stout thread, ligatured and cut across. The injection of a few drops of eucaine solution into the base of the tumour renders the operation painless.

Solitary pedunculated fibromata of large size frequently grow from the perinæum and its neighbourhood. In operating on these cases hæmorrhage must be guarded against by carefully dissecting through the pedicle and ligaturing all vessels as they are divided; the skin edges are then brought together and the stump buried.

In the severest forms of molluscum fibrosum extensive tracts of skin and subcutaneous tissue become involved in the fibromatous process and huge pendulous masses result which have received the name of pachydermatoceles. Extensive plastic operations are required for the removal of these formations.

Tubercula Dolorosa is still another variety of neuro-fibroma. It is a painful little subcutaneous nodule, and is met with most frequently on the limbs. It rarely exceeds a grape seed in size, is usually solitary, and is so painful that excision is essential.

Amputation Neuromata are really fibromatous in nature, although small medullated nerve fibres are found embedded in them. They form bulbous enlargements at the end of one or more of the nerves in an amputation stump and frequently give rise to such severe pain that the use of an artificial limb is impossible. When operating on these cases, if a distinct swelling cannot be felt, the site of the tender spot must be marked on the skin before the patient is anæsthetised. A longitudinal incision is then made, the affected nerve exposed, and its enlarged extremity removed along with several inches of nerve trunk, if that is possible.

Plexiform Neuro-fibroma results from diffuse fibromatous thickening of a nerve plexus. Large tumour-like masses are produced which cause considerable deformity. They are met with on the limbs and have been seen in the tongue. Great deformity or great pain may justify an attempt to remove such a tumour.

Apart from the groups definitely connected with nervous structures, fibromata constitute rather a heterogeneous class of tumours, having very little in common beyond their histological structure.

Certain of them have such constant clinical features that they have received special names.

Desmoid is a form of fibroma which grows between the muscle planes of the abdominal wall. It is usually solitary, of round or oval shape, and is often flattened from before backwards, no doubt owing to the pressure to which it is subjected. In excising such a tumour it is necessary to remember the proximity of the peritoneum and also to avoid extensive injury to the muscles in order to prevent the subsequent formation of a ventral hernia.

Cheloids were formerly spoken of as true or false according as they arose spontaneously or in pre-existing scars. Inasmuch as the presence of a minute scar cannot be disproved in the case of a "spontaneous" cheloid, this classification is no longer used. Cheloids may occur in almost any kind of scar. The characteristic which distinguishes a cheloid from a merely hypertrophied scar is the fact that it extends far beyond the confines of the scar from which it originated. Operation wounds, burns, vaccination marks, and even the minute punctures caused by electrolytic needles, may all undergo cheloid change. In those savage races who practise mutilation extensive cheloids frequently develop in the self-inflicted wounds.

Treatment is most unsatisfactory; it is therefore fortunate that, apart from the disfigurement, the symptoms are comparatively unimportant. Nevertheless severe pain occasionally occurs and treatment becomes necessary. When excision is carried out the operation scar and even the stitch holes often become cheloid in their turn. However, if the wound is left unsutured and is covered with Thiersch grafts, this is much less likely to occur. Operation should never be undertaken until a thorough trial has been made of X-ray treatment, which often gives good results.

The injection of fibrolysin has not proved of any value in this affection.

Epulis is probably an inflammatory condition resulting from carious teeth. Care must be taken to distinguish an epulis from a myeloid sarcoma, which it much resembles. The first step in treatment is consultation with a dentist with a view to the detection and extraction of carious stumps. If none be obvious, a skiagram of the jaw will sometimes reveal a root hidden away under the tumour. Spontaneous disappearance of the epulis is likely to occur when this has been extracted, but it may be hastened by excision of the projecting portion of the tumour (*see* Diseases of the Jaws).

Pharyngeal Fibromata.—Sessile or pedunculated fibromata occur with some frequency in the pharyngeal cavity. Tumours of small size grow from the palate and the pillars of the fauces, but the most usual site is the roof of the naso-pharynx, where very large growths are met with.

The latter tumours should always be very freely excised, as they show a considerable tendency to recur and may ultimately acquire the characteristics of sarcoma.

Paget's Recurrent Fibroid was a name given to hard fibroma-like tumours which persistently recurred after removal. There is little doubt that they were slowly growing fibro-sarcomata.

Indeed, the border line between fibroma and sarcoma is a narrow one which probably is often crossed, a strong argument for the early and complete removal of all hard fibromata or supposed fibromata.

The conversion of fibroma into sarcoma is particularly seen in cases where the original tumour shows evidence of myxomatous degeneration.

Rodent Ulcer.—Owing to the superficial nature of rodent cancer its complete destruction may be accomplished by a great variety of methods, but in spite of the high degree of perfection to which some of these methods have now attained, the fact remains that *complete excision*, followed where necessary by the application of accurately fitting Thiersch grafts, is still the most certain and satisfactory means of treating rodent ulcer we possess. It would probably not be beyond the truth to state that nine out of ten medical men, thoroughly conversant with all the modern methods of treating this condition, would choose excision should rodent ulcer attack their own persons.

Operation may however be impossible or inadvisable. The position of the growth may be such that its excision would result in serious mutilation, or it may be inaccessible or too extensive for complete removal to be possible. In the face of any of these conditions there is a choice of several methods.

The first great advance in the treatment of rodent ulcer was the introduction of the use of X-rays. Until quite recently a great drawback attending the use of X-ray treatment was the impossibility of estimating dosage, a fact that probably explains the conflicting nature of the results obtained in different cases. In many instances the dose was certainly too small, in others it was probably too great, intractable X-ray burns resulting. Cicatrization has frequently followed the X-ray treatment of rodent ulcer, but only too often the cicatrix has broken down again. This is probably to be explained on the ground that the rays have not penetrated the tissues in sufficient quantity to destroy the more deeply situated portions of the tumour.

Until some means can be devised for estimating the dose that the deeper layers of the growth are receiving, it is probable that the use of X-rays will be restricted to the palliative treatment of extensive rodent ulcers past the hope of cure by any other means at present at our disposal.

The use of *radium* does away with many of the disadvantages of X-rays. By means of suitable filtration large doses can be used without danger; moreover, its emanations are more powerful and penetrate more deeply than X-rays, while a small tube of radium can be employed in positions which would be inaccessible to other modes of treatment.

Small rodent ulcers are cured, or at any rate heal up, after a single prolonged application ; and radium treatment has the great advantage over all other methods of treatment, that it leaves practically no scar. When it is remembered that the vast majority of rodent ulcers occur on the face, this fact assumes great importance.

A drawback to the systematic use of radium in all cases is that the lapse of time is the only test we have as to whether the deep portion of the growth has been affected equally with the surface. When the methods of radium therapy have advanced sufficiently to enable us to assure ourselves on this point recourse to excision need no longer be considered.

Destruction of rodent ulcers by *freezing* has recently been introduced. This was at first accomplished by the application of a pledget of cotton-wool soaked in liquid air. But liquid air is difficult to obtain, not easy to manipulate, and it has entirely been replaced by *solid carbon dioxide.* This is quickly produced by allowing a stream of compressed carbon dioxide gas, liberated from the ordinary iron cylinder of commerce, to play into a tubular chamois leather bag. The bag rapidly fills with feathery snow, which is collected, placed in a metal cylinder and compressed with a plunger. A candle-like mass of compressed snow is thus obtained which will last for two or three hours. If properly made it should have the appearance and consistency of camphor. A small rodent ulcer is treated by the direct application of a snow candle of somewhat larger diameter than the growth. The period of application and the pressure to be applied in different cases can only be learned by experience; but generally speaking a pressure of 4 oz. kept up for forty to sixty seconds will suffice for the first application.

On removing the snow the tissues will be frozen solid, but they rapidly thaw and regain a normal appearance in a few minutes. Slight reaction follows after a few hours, and in a few days the surface becomes covered with a hard dry scab. After two or three such applications at intervals of ten to fourteen days the rodent ulcer will be found to have disappeared, leaving in its place an extremely satisfactory scar. It may be added that the whole process is practically free from pain.

It cannot be said that this method is as satisfactory as radium, but where the latter cannot be obtained it is an excellent substitute. And in cases of extensive growth it may be used to check peripheral extension or to destroy outlying nodules while the main portion of the ulcer is undergoing other treatment.

II. THE GENERAL PRINCIPLES OF THE TREATMENT OF CANCER.

Preventive Treatment.—Pre-cancerous conditions; malignant degeneration of simple tumours; cancer infection.

The Diagnosis of Cancer.

The Operability of Cancer.

The Radical Treatment of Operable Cancer.

Cancer complicated by other conditions.

Post-operation Treatment.

PREVENTIVE TREATMENT.

Pre-cancerous conditions.—It has long been recognised that there are certain chronic conditions of the skin and mucous membrane which in varying degree are likely to be complicated by the development of cancer. Of recent years much careful research has been directed to this aspect of the ætiology of malignant disease, and each day fresh evidence accumulates that cancer rarely, if ever, originates in healthy tissues.

It is logical, therefore, to preface discussion of the radical treatment of malignant disease by consideration of these *pre-cancerous states*, the treatment of which may be fairly claimed as a preventive treatment of cancer.

The numerous pre-cancerous conditions to be described constitute a miscellaneous group of lesions which at first sight appear to have little in common beyond their liability to cancer. Although the naked-eye appearances are so dissimilar, recent research has shown that the microscopic characters of the lesions have many points of resemblance. Many of the conditions under discussion are in the nature of a chronic dermatosis, accompanied by more or less wart formation. It is these warts which are usually the starting point of the malignant growth.

X-ray dermatitis is, perhaps, the best example of a pre-cancerous state. The cancer incidence is very high, in fact, carcinoma has developed in a majority of the cases, and in several instances the growths have been multiple. The intimate relationship between this form of dermatitis and carcinoma is incontestable.

Other forms of pre-cancerous dermatosis resulting from the action of a definite agent are: Paraffin eczema, met with on the arms of paraffin (wax) workers; arsenical dermatitis, caused by prolonged administration of the drug or by handling the raw product; fuel-workers' eczema, occasioned by the tar or pitch from which the fuel is made; soot eczema or soot warts, met with in sweeps and soot dealers; and finally, the aniline eczema of aniline oil workers.

Another interesting lesion is the dermatitis found on the legs of engine-drivers as the result of the intense heat radiated from the stokehole of the furnace.

In all these conditions squamous cell carcinoma frequently occurs, and this is so fully recognised that the resulting growths have received the distinctive names of X-ray cancer, fuel-workers' cancer, sweeps' cancer, aniline cancer, and engine-drivers' cancer. Collectively they constitute the "trade" or "occupation" cancers.

Scars of various kinds, particularly the scars of burns, become the seat of carcinoma. A most striking example of this is furnished by the kangri cancer of Kashmir. The natives of this country, for purposes of warmth, carry a small pottery receptacle (the kangri) filled with burning charcoal. In cold weather the owner squats upon the ground and clasps his pot so that it comes in contact with the abdomen and inner surface of the thighs. The inevitable result is that these areas of the body become scarred by burns, and in these scars carcinoma so frequently develops that kangri cancer constitutes one of the commonest diseases in Kashmir. It is an interesting and important fact that these growths are often multiple. Both thighs and the abdomen may be affected in the same person.

The *brand cancers* of cattle have a somewhat similar origin; they are squamous carcinomata arising in the scars caused by the branding iron.

Lupus is a frequent source of carcinoma. The association of the two conditions appears to have become more common since the universal adoption of X-ray treatment. At least such is the general consensus of opinion. Satisfactory statistics bearing on the point are impossible to obtain.

Leucoplakia is widely recognised as an important precursor of carcinoma of the tongue and buccal cavity. Morris, and more recently Berkeley and Bonney, have satisfactorily proved the still closer connection between carcinoma and leucoplakia of the vulva. Bonney has also shown that the condition known as erosion of the cervix uteri is closely allied in its histological features with leucoplakia, a significant fact in view of the supposed association between cervical erosion and carcinoma.

This makes a very long list of pre-cancerous states, but the fact that carcinoma does originate with considerable, though varying, frequency in all of them is beyond dispute.

It is very generally the custom to speak of "chronic irritation" as a cause of cancer. This is a meaningless expression. It is true that chronic irritation, *i.e.*, continued mechanical, chemical, thermic or parasitic injury, produces these varied pathological conditions in which cancer frequently (but by no means always) arises. But this is all we know. As to why cancer develops in these cases we know nothing.

None the less it is obvious that certain kinds of cancer would not occur were it not for the existence of these lesions produced by chronic irritation. Their radical treatment is therefore of the utmost importance.

An important step in treatment is of course the prevention of further irritation by removing such agents as produce it. But this is not enough, for these cases are usually well developed before coming for treatment; moreover, in all cases the lesions when once established appear to be of a progressive nature. It is not uncommon for cancer of the scrotum to arise in a sweep who has long since given up his avocation, or cancer of the hand in an X-ray operator who has suffered no exposure to X-rays for many months or even years.

The usual history of all these pre-cancerous states is slow but steady development for a number of years. Then, at one point, a wart or a little ulcer becomes noticeable owing to pain, tenderness, or increasing size. In leucoplakia a wart or fissure makes its appearance where previously there was none; or the scar of a burn breaks down, heals up, and once more breaks down until an ulcer is produced which will not heal. These warts, fissures, and ulcers are the heralds of approaching carcinoma, and must be dealt with radically: not by the application of caustics, nor of X-rays, nor indeed of anything, but by complete excision, followed, if need be, by the use of Thiersch grafts, which completely and accurately fit the denuded surface.

Undoubtedly it is the ideal to treat all acknowledged pre-cancerous states by excision of the whole affected area; but this is probably not necessary, and is certainly not practicable. In the majority of cases it will doubtless suffice to follow the lines indicated and promptly excise any "suspicious" point, whether one is dealing with leucoplakia, lupus, scars of burns or any other of the conditions described. In certain lesions, however, the liability to cancer is so great that more drastic measures are advised. For instance, in radio-dermatitis every wart and every persistent crack or ulcer should be excised and the wound grafted. Again, in leucoplakia of the vulva Berkeley and Bonney have found the incidence of cancer so high that they have followed out their researches to a logical conclusion and practise complete excision of the affected area in every case.

Thus far only the external carcinomata have been considered; the very fact that they are external renders their mode of development easy of observation. Of the early history of internal cancers we know but little.

A close association between chronic inflammatory conditions of the *gall-bladder* and carcinoma of that organ admits of very little doubt, and it has lately been urged by many skilled observers that carcinoma of the *stomach* has a chronic simple ulcer as its most frequent starting point. Beyond these, with the possible exception of a connection between bilharziasis and carcinoma of the bladder, our knowledge concerning the precursors of visceral cancer does not extend. But if one may argue from the analogy of the external carcinomata, it is extremely probable that future research will materially extend our knowledge in this direction, and reveal well-defined pre-cancerous states in the mucous membrane of the alimentary tract and other viscera. Systematic investigation of this subject should furnish interesting and valuable information which will have an important bearing on the question of treatment.

Already in the case of the gall-bladder and the stomach the trend of surgery is in the direction of radical preventive treatment. Cholecystectomy has taken the place of cholecystostomy for chronic inflammations of the gall-bladder; and excision is replacing gastro-enterostomy or purely medical measures in the treatment of chronic gastric ulcers.

Malignant Degeneration of Simple Tumours. — It is necessary now to consider the question of the conversion of "simple" tumours into those with all the characteristics of malignancy.

It is quite certain that this happens; how often it is impossible to say. Every surgeon has met with instances in which a perfectly simple tumour, after remaining quiescent for many years, has suddenly commenced to extend in size and to infiltrate adjoining parts—in fact, has developed all the features we are accustomed to associate with malignancy. In the majority of cases the change of type appears to be quite spontaneous, but in certain instances it apparently follows some mechanical injury, or, as in the case of warts of the lip and tongue, the application of silver nitrate, acetic acid, or some other caustic irritant. Again, the incomplete removal of certain tumours which are clinically of simple nature is occasionally followed by recurrence and change of type. Notably is this the case in simple papilloma of the bladder; and it is therefore now the custom to remove the growth by complete excision of the area of mucous membrane from which it springs.

An excellent example of spontaneous change of type is afforded by the pigmented moles or even small pigment spots, which suddenly increase in size and give rise to generalised melanotic cancer, after an innocent existence of many years. The conversion of an apparently simple fibroma into a tumour having all the clinical and histological characters of sarcoma has already been referred to. These facts are the strongest possible arguments for the early and complete removal of all tumours, however innocent they may appear to be.

Cancer Infection.—In spite of "cancer houses" and the alleged occurrence of "cancer cages" in the case of mice, there is no scientific evidence that cancer is ever communicated from one individual to another. It is true that numerous cases of cancer *à deux* (e.g., cancer of the penis in the husband and cancer of the cervix uteri in his wife) have been recorded, but the event is so relatively uncommon that coincidence may be advanced as a perfectly adequate explanation.

However, in view of our entire ignorance as to the causative agent of cancer, disinfection of rooms and sterilisation of bedding used by cancer patients is a perfectly reasonable and proper proceeding, which is now largely adopted; the formalin spray being the disinfectant agent most commonly employed.

Local infection of cancer in the same individual is quite a different matter; here the evidence is very definite and convincing. It is, of course, the process which naturally occurs when growth permeates lymphatic channels and produces metastasis in distant parts. But the cancer cells need not necessarily travel along lymphatic channels; they may be conveyed by outside agencies. Careless technique or rough manipulation during the removal of a malignant tumour may result in the implantation in the wound of cancer cells which grow there and give rise to what are really artificial secondary deposits. Charles Ryall has described cases in which even stitch holes and the openings for drainage tubes have become the site of little metastatic growths.

Therefore, when operating for malignant disease, the greatest care should always be exercised to prevent rough handling of the growth and, above all, to avoid cutting through cancerous tissues. If the latter is inevitable and it appears probable that cancer cells have been scattered about, an attempt should be made to remove them by thoroughly flushing out the wound. At the same time gloves and instruments that may have become infected should be replaced.

THE DIAGNOSIS OF CANCER.

While the question of diagnosis does not properly come within the scope of this article, there is one point which demands consideration here. The ordinary methods of clinical investigation sometimes fail to elucidate the nature of a tumour, and it is still an open question as to how far the use of such aids to diagnosis as the exploring needle or exploratory incision are justifiable when dealing with a possibly malignant growth.

By some surgeons the view is very strongly held that the use of these methods is likely to be followed by the forcing of cancer cells into lymphatic channels, or by their dissemination along the track of the needle or knife. It is conceivable, but seems hardly probable, that a hollow needle could be thrust so forcibly into a tumour as to cause some of its cells to be squeezed into the surrounding lymph channels. In any case the needle only informs us as to whether a tumour is solid or cystic. It tells us nothing of the nature of solid tumours, and oftentimes is no help in cystic tumours.

Exploratory incision is another matter; the information it affords is much more complete. There is, however, real danger of infecting healthy tissues with an infected knife, but this can be guarded against by careful precautions; and exploratory incision should certainly be practised whenever there is reasonable doubt as to the malignant nature of the tumour.

To obviate the necessity for two operations the patient should always be prepared for the major operation, in case events prove it to be necessary. If possible the doubtful tumour should be completely removed from the body before an incision is made into it. If it proves to be malignant, the wound is closed with sutures or clips, and carefully covered; all infected instruments and gloves are replaced and a radical operation is then performed.

When, owing to the nature of the tumour, it is not possible to follow this procedure, the mass should be incised to a sufficient extent to allow of free exposure of the growth. If it is found to be malignant the case is dealt with as before.

It sometimes happens that even this thorough exploration does not clear up the diagnosis. In that case material must be removed for pathological examination and the wound closed.

It is the practice of some surgeons to have a pathologist in waiting, who rapidly cuts a frozen section and gives an opinion as to the nature of the growth while the patient is still anæsthetised. The operation is then completed according to the pathological finding. It is only in exceptionally difficult and doubtful cases that the surgeon requires the assistance of a pathologist, and such cases usually require more detailed investigation than is possible with frozen sections in the operating theatre.

THE OPERABILITY OF CANCER.[1]

When we speak of a malignant growth as operable we mean that the growth is such that we *suppose* we are able completely to remove it. How frequently this supposition proves incorrect the experience of every operating surgeon furnishes ample evidence.

Time is the only test as to the "operability" or otherwise of a malignant neoplasm. The application of the terms "operable" and "inoperable" can only be arbitrary, and in fact is largely influenced by the personal equation of the surgeon. If he thinks he can so plan an operation in any given case that there is a reasonable chance of entirely ridding the patient of the disease, then the case is operable. If, on the other hand, the growth is so fixed to important structures that its removal is impossible, or if there are visceral, skeletal, or widespread glandular metastases, then the case is classed as inoperable.

But the surgeon is often wrong. A most carefully planned and conscientiously performed operation in a favourable case may be followed by early and widespread recurrence; while operations in more advanced cases, which look most unfavourable, may be followed by complete success.

It is quite impossible to foretell when recurrence will take place. There are many instances of a tumour recurring locally ten years after operation, and other cases in which, although the primary site has remained healthy, secondary deposits in the glands or viscera have declared themselves after an equally long interval of time. It is therefore obvious that no case of cancer can ever be spoken of as certainly cured; but inasmuch as the vast majority of recurrences arise during the first two or three years after operation, the chance of permanent freedom from recurrence increases rapidly after this period is passed.

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[1] In accordance with almost universal usage, the term "cancer" here includes all forms of malignant growth, whether carcinoma, sarcoma, or endothelioma, unless the context makes it clear that otherwise is intended.

What has gone before shows the absurdity of the claims of those who hold that any case remaining well three years after operation is to be regarded as permanently cured, any subsequent recurrence being looked upon as a fresh development of cancer. This is subversive of all we know of the pathology of cancer. A deposit of squamous cell carcinoma in the cervical glands three and a half years after the removal of a carcinoma of the tongue cannot by any subtlety of pathology be adduced as a new-formed primary growth.

THE RADICAL TREATMENT OF OPERABLE CANCER.

In the present state of knowledge, the only treatment of cancer that can be regarded as radical consists in effecting complete removal of the primary growth and all its offshoots.

Inasmuch as in any given case it is impossible to determine the exact limitations of the growth, it is highly essential that we should possess very definite clinical and pathological knowledge as to the relationship the various types of malignant growth usually bear to the organs or tissues in which they arise; as to whether they tend to spread to more distant parts, and if so, as to the manner in which this extension takes place.

There is much still to be learned concerning the pathological anatomy of cancer, but this much we know. The growth of a malignant tumour is unlimited; wherever it arises it infiltrates surrounding tissues by direct extension until its progress is stayed by surgical intervention or by the death of the patient. This is the most characteristic feature of malignancy.

The local extension of a growth is in large part the result of cell multiplication, although it has been held that malignant conversion of normal cells in the immediate neighbourhood of a neoplasm may occur. A. Leitch has shown that this probably occurs in certain forms of mammary cancer.

It is often stated that the local extension of cancer is a centrifugal process that knows no anatomical boundaries, and, generally speaking, this is true. But there are certain factors which do exercise an important influence in determining the directions in which a primary growth shall extend.

G. L. Cheatle has drawn attention to the fact that the extension of rodent ulcers tends to be limited by the boundaries of the cutaneous nerve areas in which they originate. The same

Accurate knowledge of the anatomy of the lymphatic system is necessary in order to obtain a clear conception of the permeation theory. Broadly speaking, the whole of the deep fascia of the body is overlaid by a network of freely anastomosing lymphatic channels. This network is divided up into certain catchment areas which drain by trunk lymphatics into the regional lymph glands. There is, however, a very free anastomosis between neighbouring lymphatic areas.

From this deep lymphatic plexus vertical offshoots pass upwards and connect it with the skin and with any subcutaneous organ, such as the breast. In addition to these superficial offshoots of the plexus there are certain points where it has connections with the deeper structures. For instance, at the uppermost part of the linea alba lymphatics pierce the abdominal wall and reach the round and falciform ligaments, in which they travel to the liver. Again, at certain points the deep fascia has intimate connections with the bones, i.e., just below the great trochanter it is adherent to the femur, and at the insertion of the deltoid it is fixed to the humerus. There is evidence that at these two points the fascial plexus of lymphatics sends offshoots into the bone.

It has long been known that invasion of the sub-mammary plexus is an early event in cancer of the breast, and by this means particles of growth reach the axillary glands vià the trunk lymphatics. But by means of serial microscopic sections of long strips of tissue Handley has shown that when the sub-mammary plexus is invaded, those cancer cells which escape transportation to the lymph glands remain and grow along the lines of least resistance, i.e., along the freely anastomosing lymph channels, which it will be remembered are merely part and parcel of the widely extending fascial plexus. In a little while, therefore, certain of these channels become occupied by long cylinders of cancer cells which by continued growth extend ever onwards away from the parent neoplasm; that is to say, extension takes place by centrifugal permeation of the lymphatics radiating from the tumour.

It now becomes easy to understand the formation of metastatic growth. One of the small cutaneous offshoots of the fascial plexus becomes permeated; its cutaneous termination is a blank wall as it were; permeation can extend no farther, proliferation of cells is still occurring, and so a spherical subcutaneous nodule is produced—a common event in advanced mammary cancer.

In this way, metastatic nodules may be produced in any part of the deep fascial plexus or its ramifications. Deposits in the liver are to be explained by permeation of the lymphatics that penetrate the upper part of the linea alba. In fact, permeated lymphatics have been demonstrated actually within the falciform ligament. Skeletal deposits in such distant parts as the middle of the humerus or the upper end of the femur are explained by the connection which the fascia has with the bone at these points.

Time is an important factor in permeation; it is not a rapid process and therefore it follows that except in cases of very long duration all the secondary nodules are within a comparatively short distance of the primary growth. It is owing to this that such distant parts as the hand and foot are never the seat of metastatic growth in cancer of the breast. The patients do not live long enough to allow the process of permeation to reach so far.

It is now necessary to consider in what way this conception of the mode of spread of cancer should influence treatment. It is quite obvious that clinically we cannot detect the presence of permeated lymphatics except by the evidence furnished by the formation of metastases—when it is usually too late for radical treatment; and it is also obvious that any operation will be useless unless the area of tissue removed includes the primary growth and the whole extent of each permeated lymphatic proceeding from it. It is, of course, impossible to make certain of doing this in any given case; we can only attempt it. Our knowledge of lymphatic anatomy will teach us the position in which permeated lymphatics are likely to be found, and the size and situation of the growth and the amount of glandular infection will furnish some indication of the degree of permeation that may be expected to have occurred. There are however many pitfalls, for wide permeation may be present with but little glandular enlargement. It is also useful to remember that the lymphatic glands in the neighbourhood of a carcinoma may be considerably enlarged and yet prove to be entirely free from growth.

The most important lesson to be learned from the facts of lymphatic permeation is that no operation for malignant disease can be regarded as radical unless it has for its object not only the excision of the growth itself but also the removal of a sufficient area of all tissues likely to be invaded; that is to say, that our operations should always, as far as possible, consist in the removal of an area of tissue which has the growth for its centre. Thus in the case of breast cancer, it comes about that "the centre of the growth, not the centre of the breast, must be taken as the central point of the operation throughout. The removal of the mammary gland is merely a necessary incident of the operation and not its sole object" (Handley).

Similarly, in other forms of carcinoma, the aim of the surgeo should be not only the complete removal of the growth and wher possible the organ in which it arises, but also the freest possibl ablation of all surrounding tissues in which permeated lymphati may be lying. These ideals have now been rendered possible i the case of cancer of the uterus by the work of Wertheim, and i the case of cancer of the rectum by the work of Ernest Mile and Handley; although owing to the anatomical difficulties th operations now carried out for these two conditions have n reached, and probably will never reach, the completely logical an satisfactory status of Handley's operation for cancer of the breast.

OPERATIONS ON CANCER COMPLICATED BY OTHER CONDITIONS.

When cancer is complicated by other important conditio the question of its radical treatment requires special consideratio

Cancer in Pregnancy.—Unless labour is imminent nothing ca justify delay in performing a radical operation. In cases mammary cancer during pregnancy the growth advances with suc fearful rapidity that operation, if feasible, should be undertake with the least possible delay. The conjunction of pregnancy an carcinoma of the cervix uteri is fortunately uncommon. If th growth be operable abdominal (Wertheim's) hysterectomy shoul be performed. When radical treatment is impossible the uter should be emptied in the hope of diminishing the rapidity of growt Very great difficulty may be experienced in getting the fœt through the rigid cancerous cervix if pregnancy be advanced, an it is then probably less dangerous to perform Cæsarean section.

Diabetes and Renal Disease.—It is usually stated that patien with diabetes or renal disease bear operations very badly. It pr bably would be more true to say that they bear anæsthetics badl Unless a renal or diabetic patient is so bad that a fatal terminatio appears probable within a short time, operation should not withheld. But it must be preceded by treatment calculated reduce the amount of toxic material circulating in the blood, and general anæsthetic should if possible be avoided. It is in thes cases that infiltration and spinal anæsthesia find a valuable an legitimate field of usefulness.

Jaundice.—By the time that malignant disease has occasione jaundice it is usually too advanced for radical treatment. If hov ever any operation be considered necessary, the grave danger uncontrollable hæmorrhage resulting from the decreased coagul bility of the blood requires serious attention. The coagulatio time should always be estimated, and if found to be above normal, calcium lactate or calcium chloride must be steadily administered in doses of 20 gr. at regular intervals of six hours. From time to time the coagulation time is again estimated, and when normal or nearly normal the operation may be undertaken. It is important that every oozing point should be dealt with by *ligature*. Twisting or forcipressure cannot be relied upon.

The intravenous injection of animal (rabbit) serum has recently been introduced as a means of increasing the coagulability of the blood in jaundice and hæmophilia, and appears to be highly successful. In one instance a single injection reduced the coagulation time from twenty to four minutes (Beach).

If it proves impossible to reduce the coagulation time to normal or nearly normal it is questionable whether any operation is justifiable.

POST-OPERATIVE TREATMENT.

No matter how carefully an operation for cancer has been performed it is always possible that a few cancer cells have been shed in the wound or that an outlying nodule has escaped removal. Unless these cells are destroyed, recurrent growth will almost inevitably occur.

Radium and X-rays we know to possess the power of inhibiting the growth of cancer cells; or of actually destroying them when few in number and sufficiently near the surface to receive a large dose of active rays.

At the present time the use of radium as a prophylactic measure is out of the question, as no one possesses a sufficient amount to influence the necessarily large area that requires treatment.

With **X-rays** it is different; and many surgeons now make it a practice to treat their cases after operation by exposure of the wound area to the rays.

This prophylactic use of irradiation is an entirely logical procedure, although our lack of knowledge as to the depth to which X-rays penetrate in useful quantity, and the difficulties in estimating dosage, limit its systematic employment.

It is obvious that large doses must be employed if any benefit is to be expected, and considerable care and judgment are necessary to avoid injury to the skin.

C. Lyster, who has had much experience in this branch of radiotherapy, waits until healing is well advanced and then gives a measured dose three times a week for a fortnight, the total quantity of rays administered being equivalent to two Sabouraud pastille doses.

It has been suggested that X-ray burns are obviated, and the rays brought into closer contact with any cancer cells that may be present, if the operation wound be left unsutured until the exposures have taken place. Although this method permits of the employment of very considerable doses and has other important theoretical advantages, there are many practical difficulties in the way of its adoption except in a few special cases.

Coley's Fluid.—The prophylactic use of Coley's fluid after operation for sarcoma will be described later (*see* p. 152).

III. THE TREATMENT OF INOPERABLE CANCER.

As by inoperable cancer we mean cancer which is incurable by any means at present known to science, it follows that its treatment resolves itself into the treatment of symptoms.

We have more than this however to consider, for inasmuch as the vast majority of cases seen in the early, i.e., operable, stage undergo radical operation, it follows that it is only in the inoperable cases that new remedies suggested or claimed as cures for cancer can be investigated. The treatment of nearly all cases of inoperable cancer therefore consists primarily in the relief of symptoms by measures which have found an acknowledged place in surgery, and secondly in the use of one or other of the numerous empirical methods of treatment that are still on their trial. The relative importance of the two things must not be confounded. But dying men clutch at straws, and it not infrequently happens that patients reject the substance for the shadow, and refuse some tried and scientific measure in preference for a nostrum which has gained ephemeral fame in the columns of the daily press.

So numerous are the varieties and situations in which cancer occurs that it is not possible to describe in detail treatment for the relief of each and every form. The plan which will therefore be adopted is the description of the measures that may be used in dealing with the important symptoms and complications of inoperable cancer generally.

It is hoped that this arrangement of a very large and diffuse subject will permit full consideration of all essential matters without reiteration and overlapping.

Treatment may conveniently be studied under the following headings:

The Palliative Removal of Growths.
The Relief of Cachexia.
The Relief of Pain.
The Control of Ulceration, Hæmorrhage, and Discharge.

The Relief of Obstructions.—Alimentary; respiratory; urinary; biliary.

The Relief of Certain Special Symptoms.—Brawny arm; hydro-thorax; hydro-peritoneum.

Empirical Treatment.—Drugs; organo-therapy; serums and vaccines; electro- or radio-therapy.

PALLIATIVE REMOVAL OF GROWTH.

The major part of the suffering occasioned by cancer results from the breaking down of the primary growth and the formation of foul, ulcerating masses, which are the source of intolerable distress both to the patients and to all who come in contact with them.

In many cases, although glandular or visceral deposits render the case "inoperable," it may still be possible to remove the primary growth more or less completely. Opinions are divided as to how far a palliative operation of this nature is justifiable. It is urged that incomplete operations sometimes result in aggravation of the local condition. But the evidence on this point is not conclusive. It is true that in some cases recurrence quickly takes place, but even then it is open to question whether the patient is any worse off than if an operation had never been attempted; while on the other hand, in a large proportion of these cases, the patients remain free from any local return of the disease during the comparatively short period of life remaining. This is a very considerable gain, to obtain which the majority of patients would be willing to run the risk, if there is any risk, of possible aggravation of their condition.

The number of cases in which the palliative removal of a malignant growth is possible is unfortunately not large. Breast cancer most often provides suitable opportunities, but other examples in which great relief may be afforded by this means are the removal of a testicle, hugely distorted by sarcoma, even when secondary deposits in the abdomen are manifest; the amputation of a sloughing carcinomatous penis, in spite of extensive glandular infection; or the excision of a blind and painful eye, the seat of melanotic sarcoma, when general melanosis is established. Even in cases of sarcoma of bone, where the presence of metastases indicates a fatal termination, the pain or the unwieldy size of the tumour may justify the amputation of the limb, if only to give a few weeks' respite.

Similarly, partial gastrectomy in carcinoma of the stomach may be justifiable when the presence of irremovable glands renders the ultimate prognosis hopeless.

Whatever has been said about palliative operations for primary growths also applies to local recurrence after attempts at radical treatment, but the number of suitable cases is naturally smaller.

Whenever palliative operation is proposed, it is essential that its exact nature and limitations should be fully explained, as any misunderstanding as to the degree of benefit likely to accrue is apt to bring discredit to the surgeon and the art of surgery.

There are two points in the operative technique that require special attention. Firstly, in many of the cases there is present an ulcerated surface which is a source of danger from the point of view of septic infection of the wound. The author has found that by covering up the ulcerated surface with gauze and collodion the day before the operation and then freely applying tincture of iodine to the whole operation area, this danger is reduced to a minimum.

Secondly, inasmuch as these are all advanced cases, there is an increased risk of cancer infection of the tissues. This must be obviated by thoroughly flushing out the wound; antiseptics such as perchloride of mercury have been used for this purpose, but we have no definite evidence that antiseptics can destroy cancer cells, and it is probable that the mechanical effect of the copious use of sterile saline solution is sufficient to rid the wound of any loose particles, whatever their nature.

THE RELIEF OF CACHEXIA.

It has long been customary to speak of the cachexia of cancer as if it were a definite clinical entity, characteristic of cancer *per se*. There is little to support this view. Patients suffering from large malignant growths are constantly met with who present no evidence of cachexia whatever. It is true that, when exhausted by hæmorrhage and discharge and profoundly toxic as the result of absorption from the surface of the growth, patients present a sufficiently characteristic appearance to render their deplorable condition patent to the most casual observer. But to say that this appearance is special to cancer is not in accordance with ascertained facts. Similarly, Bashford finds that mice with enormous tumours remain in good general health for a long period and that cachexia only declares itself when the growth has broken down and ulceration and septic absorption have become established.

It may therefore be granted that cachexia is not a specific symptom of cancer, but the result of certain conditions which usually arise during the evolution of a growth; and that it only differs in degree from the cachexia accompanying other forms of wasting disease in which similar local conditions prevail. It is therefore reasonable to suggest that the general methods directed to the relief of the anorexia and emaciation of inoperable cancer should not differ from those in use in other diseases where sepsis and sloughing are prominent features.

Mr. Handley has brought forward facts which show that in many cases of cancer there appears to be some attempt at natural cure on the part of the tissues, and he suggests that patients would probably be in the best possible circumstances for this to be favoured if treated by the "Open-air" method.

Apart from any question of natural cure, it cannot be doubted that the open-air régime would be an admirable plan of treatment, especially in such cases, and they are in the majority, as are complicated by septic changes in the growth and its neighbourhood. We know how appetite improves, emaciation diminishes, and discharge lessens in other septic conditions, and there can be no reason why some such amelioration should not take place in cases of inoperable cancer.

Vaccines.—The vaccine treatment of inoperable cancer, or, to be more precise, the vaccine treatment of the septic changes that accompany inoperable cancer, is a branch of therapeutics which has not yet received the attention it deserves. The difficulties are of course very great; mixed infections are the rule, and out of the large number of organisms present in any given case it is a difficult matter to make a selection of those which have the predominant influence. But it is possible that the use of a polyvalent vaccine prepared from cultures of all the pathogenic organisms found in a malignant ulcer might be followed by considerable benefit as regards cessation of discharge, and diminution of inflammatory infiltration.

Uterine cancers should provide the most favourable field for this method of treatment, for in these cases, above all others, the inflammatory infiltration is far in advance of the actual growth. It is indeed possible that a course of treatment by polyvalent vaccines might so alter the complexion of the local condition that a case supposed to be inoperable owing to the extensive infiltration might come within the limits of operability.

THE RELIEF OF PAIN.

Fortunately pain is not invariably a prominent feature of cancer; in fact, many people die of cancer who have suffered but little pain from first to last. But when nerve trunks are involved in growth, as, for example, the brachial plexus in mammary cancer, or the sacral plexus in rectal and uterine cancer, the condition of the patient is pitiable; while, when parts which are subject to constant movement, such as the tongue, larynx, or bladder, are infiltrated by growth, suffering passes the limit of endurance.

Pain is treated by the administration of various sedative or narcotic drugs; by applications to the affected part; by destruction of the conductivity of the nerves involved; or by X-ray treatment.

Drugs.—Of the innumerable sedatives in common use, a draught containing phenacetin (10 gr.) and caffeine citrate (5 gr.) is undoubtedly the most generally useful. It should be repeated every six or eight hours and may be continued for long periods, although occasionally its administration must be discontinued owing to cardiac depression, when aspirin (10 gr.) may be substituted for the phenacetin. In a large proportion of cases nothing further is necessary, but when pain is more severe some preparation of opium must be resorted to. Nepenthe and liquor opii sedativus are two useful preparations which may be given in the following form: ℞. Liq. Opii Sed., ♏10, or Nepenthe, ♏10; Tr. Zingib., ♏5; Aq. Chloroformi, ad ʒj [U.S.P. ℞ Liq. Opii Sedativ., ♏10, vel Nepenthe, ♏10; Tr. Zingib., ♏2; Aquæ Chloroformi, ʒss; Aquam, ad ʒj]. This draught should be given at regular intervals of six hours, and will be found to give more satisfactory results than occasional larger doses, without producing unpleasant after-effects.

The hypodermic injection of morphia should be reserved to the last. If used early in the disease there is nothing to fall back upon in the later and more painful stages; moreover a craving for the drug, with all its attendant evils, frequently develops. Fear of the establishment of a morphia habit should not, however, lead to the deprivation of morphia in every case. After all, there is no drug which even approaches it in power of relieving pain and producing sleep. A wise discretion must be exercised and its use at first confined to the relief of acute exacerbations of pain or persistent sleeplessness. A dose of $\frac{1}{6}$ gr. is sufficient to give relief in the majority of cases.

The sedative effects of tobacco or of moderate quantities of alcohol need hardly be referred to.

Local Applications.—The application of anodynes to the surface of a growth is not often necessary unless the parts are so tender that changing the dressing gives pain. In that case the surface may be smeared with an ointment containing ·1 per cent. of eucaine and ·01 per cent. of adrenalin; or the slight anæsthetic properties of carbolic acid may be utilised by the occasional application of a 1 in 20 solution.

Division of Nerves.—When severe pain is more or less definitely confined to the area of distribution of one nerve or group of nerves, destruction of the nerve or nerves may be attempted by division, or by other methods presently to be described. In advanced cancer of the tongue division of the lingual nerve has been practised with considerable benefit as regards relief of pain and diminution of salivation. But the operation is not an easy one and its usefulness is considerably limited by the fact that in so many cases the mandible and floor of mouth are involved in the growth. It is obvious that the division of sensory nerves for the relief of pain is attended by many practical difficulties, and it does not appear that any nerve other than the lingual has been so dealt with except in a few isolated cases. It is probable, however, that a division of the sensory roots of the spinal nerves within the spinal canal is worthy of more extended trial than it has at present received.

Schlösser's Method.—Schlösser, of Munich, has shown that the injection of 70 to 80 per cent. alcohol into a nerve trunk results in degeneration of its fibres, and therefore in complete solution of physiological continuity. This method has been extensively adopted by neurologists in the treatment of trigeminal neuralgia, and the exact technique employed is described in Vol. II. It is obvious that many cases of inoperable cancer of the tongue, floor of mouth, or jaws would be greatly relieved by the destruction of the third or, in the case of the upper jaw, the second division of the fifth nerve. It is true that the anæsthesia is not permanent, the average period being ten months, but as the duration of life in the cases under consideration is limited to a few months, it will rarely be necessary to repeat the injection. Up to the present time there has been little opportunity of an extended trial of this method in cases of inoperable cancer, but a few examples of lingual cancer have been dealt with on these lines with results which encourage further trial.

Dundas Grant recently reported cases of advanced laryngeal tuberculosis which were much relieved by the injection of alcohol into the superior laryngeal nerve of the side chiefly affected. It would be quite reasonable to adopt the same line of treatment for the relief of pain in advanced cancer of the larynx. Dr. Grant tells me that he has (in cases of tuberculosis) injected both nerves without any of the ill effects which might theoretically be expected from a complete bilateral anæsthesia of the larynx. It is probable that the anæsthesia is not absolute. With increased experience Schlösser's method, or some modification in the case of mixed nerves to avoid motor paralysis, will no doubt be applied with benefit in many other forms of inoperable cancer. For instance, the injection of the brachial plexus in advanced mammary cancer, or of the sacral plexus in rectal cancer, are possibilities of the future.

Again, the repeated injection of weak solutions of analgesics into the spinal canal in order to produce a slight degree of spinal anæsthesia has recently been suggested for the relief of pain caused by pelvic growths involving the lower spinal nerves.

THE CONTROL OF ULCERATION, HÆMORRHAGE, AND DISCHARGE.

When a malignant growth breaks down and micro-organisms have access to it, septic infection of the disintegrating tissues inevitably follows, and hæmorrhage, discharge, and septic absorption result.

When removal of the ulcerated mass is impracticable, it is possible in some cases to limit the rate of growth by ligaturing the vessels which supply the affected part.

Owing to various technical difficulties, cancer of the tongue, upper jaw, and uterus are practically the only conditions in which this method of treatment is applicable. Even in these instances, in so far as any diminution in the size or rate of progress of the growth is concerned, the results have not been very hopeful. Diminishing the blood supply is, however, very useful in checking the troublesome and exhausting hæmorrhages which so constantly occur in all these cases.

In cancer of the tongue the lingual artery of the affected side is tied at its commencement. In malignant disease of the upper jaw (owing to the fact that anastomosis is so free across the middle line), no benefit follows the ligature of the corresponding external carotid. This difficulty may be overcome by occluding the vessel and all its branches by the injection of sterile molten wax. Or complete thrombosis may be brought about by the injection of a small quantity of boiling water. Good results have followed both these procedures.

In carcinoma of the cervix, much benefit has been obtained by ligaturing both internal iliac arteries. It is necessary to make sure that both vessels have been completely closed, as it seems that the ligature of one vessel only may make matters worse. This is neither a very lethal nor a very difficult operation, and the great improvement which is often obtained justifies its adoption in all cases where simpler measures have failed to control repeated bleeding.

It is now necessary to consider the methods to be adopted for cleansing the septic sloughing surface of a growth. Considerable amelioration may be brought about by scraping away the superficial layers of necrotic tissue in which the organisms of putrefaction are luxuriating. Free hæmorrhage often follows the proceeding, but can usually be controlled by firm pressure with swabs wrung out in very hot water; or the thermo-cautery may be used both as a hæmostatic and as a means of still further destroying the infiltrated tissues, but the sloughs that follow its use soon become reinfected with septic organisms.

In advanced cancer of the cervix acetone has recently come into use as a local application after curetting. This drug is a very powerful dehydrating agent which rapidly penetrates and hardens the tissues and renders them very resistant to bacterial infection. It is applied as follows: the patient is placed in the lithotomy position and the growth thoroughly curetted: when bleeding has ceased, a large Ferguson's speculum is introduced in order to protect the vaginal mucous membrane; 2 or 3 oz. of acetone are then poured in and allowed to remain in contact with the growth for ten minutes. The excess of acetone is removed and the vagina mopped dry. Great diminution of hæmorrhage, discharge and septic absorption have followed this method of treatment. Further applications of a small quantity of acetone should follow every four or five days. The curetting may, of course, require to be repeated in a few months.

Although up to the present time a similar use of acetone in other forms of cancer has not received extensive trial the results so far obtained are very encouraging. A drawback to its universal adoption is the pain its application causes. Another agent of the same character is amylic alcohol; this has apparently given useful results (Hosand), but does not appear to have been tried in this country. It is not so powerfully hygroscopic as acetone.

In all cases where these special methods are not possible, the routine employment of disinfectant and deodorant agents is essential.

Sanitas in weak solutions is very generally employed as a douche in mouth, uterine or rectal cases with excellent results. It is certainly the most useful agent for this purpose.

In dressing external cancers warm antiseptic fomentations are generally used. These are undoubtedly very comforting when there is much pain, but the warmth and moisture certainly favour bacterial growth. Dry absorbent dressings are probably better; they will not stick to the surface if a single layer of butter muslin damped with peroxide of hydrogen be accurately applied to the ulcer. Any discharge escapes through the meshes of the muslin, and there is no need to change it every time the outside dressing is removed. It is even possible to douche the wound without disturbing it.

In cases where the surface of a growth has many pits and crevices it is exceedingly difficult to keep it clean and free from odour. Syringing with peroxide of hydrogen (10 vols.) will be found of the greatest use in these cases. This agent is also of value for its hæmostatic properties; the application of gauze soaked in peroxide rapidly stops bleeding not arising from large vessels. It should be used pure, the addition of warm water liberates the oxygen and destroys its activity.

When discharge is in some part due to increased activity of the mucous or other glands of the affected part secretion may be diminished by the administration or local application of belladonna. For instance, in carcinoma of the œsophagus, a good deal of discomfort is often occasioned by the constant regurgitation of the copious mucoid secretion of the œsophageal glands. This may be much relieved by the administration of 2 or 3 minims of tincture of belladonna several times a day.

THE RELIEF OF OBSTRUCTIONS.

In a large proportion of cases of inoperable cancer some form of obstruction is certain to arise in the later stages.

This may occur not only in the alimentary tract but in the urinary channels, the biliary ducts or the respiratory passages; any of these may be more or less completely closed by growths arising within them or by the pressure of masses external to them.

Failing the extirpation of such a growth, some operation for the relief of obstruction becomes inevitable if life is to be prolonged. Decision as to when this becomes necessary is an important and often difficult matter.

When patients realise that the benefit likely to follow can only be of a temporary nature they are naturally anxious to postpone such measures as gastrostomy, cystostomy, or colostomy as long as possible. But it is important to remember that the border line between partial and complete obstruction is a narrow one—possibly a matter of a few hours only. And there is a vast difference between operations undertaken deliberately after due preparation and those hurriedly performed upon a moribund patient. In the latter case the surgeon is not at his best, the patient is at his worst, and the results are as might be expected.

The treatment of the various obstructions may be considered according as they arise in: (1) the alimentary system; (2) the respiratory system; (3) the urinary system; (4) the biliary system.

The Alimentary System.—Cancer of the pharynx, œsophagus, and the cardiac end of stomach call for gastrostomy. The various methods of performing this operation are described elsewhere (*see* Diseases of the Œsophagus, Vol. II.). It is, however, necessary to emphasise very specially the importance of avoiding undue delay in making the artificial stoma; for in this operation, above all others of similar nature, does fatal delay most often take place. It is a lethal proceeding to open the abdomen and manipulate the stomach of a patient who is reduced to the lowest ebb by weeks of starvation.

Some surgeons hold that gastrostomy is an operation which gives so little relief that they never advise it; but mistakes in diagnosis are always possible, and it has occurred that gastrostomy openings have required closing owing to complete recovery of the patient. No patient should ever be allowed to die of starvation owing to gastrostomy having been withheld. On the other hand, it is certain that a few patients are condemned to this unpleasant mode of taking nourishment too early.

Operation need not be considered so long as the patient is able to take an adequate amount of such liquid food as milk, meat juice, or raw eggs. When this stage is passed gastrostomy must not be delayed. It not infrequently happens that a patient who has been taking a fair quantity of liquid nourishment suddenly finds it impossible to swallow anything. Such an attack usually passes in twenty-four hours or so, but the repetition of so exhausting an experience must be prevented by early operation.

Another circumstance favouring early operation is the discomfort occasioned by constant regurgitation of food which has collected in the ballooned œsophagus above the growth.

The weight gives important information as to the progress of the case. Great loss of weight occurs in the earlier stages, but later, it has reached an almost irreducible minimum and subsequent loss is very slow and gradual. Patients should be weighed at frequent intervals, and any sudden increase in the rate of loss is an indication for early operation.

It is fatal to delay gastrostomy in the hope that the condition of the patient may improve and his chance of surviving be enhanced. His condition very rarely does improve.

In a few cases of œsophageal cancer the onset of obstruction has been delayed and the condition of the patient much improved by an ingenious method of treatment suggested by Sampson Handley. It consists in giving small doses of trypsin at very frequent intervals. The following solution is made up: Trypsin, gr. 2; Sodii Bicarb., gr. 20; Aquam, ad ℥iij; and one teaspoonful of this is administered by the mouth every hour. By virtue of the powerful digestive action of the trypsin, partial solution of the growth is effected, with the result that the degree of obstruction is considerably diminished. The improvement is of course of a temporary nature only, but some very striking results have been obtained. The progress of the case can be readily demonstrated by X-ray examination following the administration of a bismuth meal. A possible risk attending this method of treatment is the production of a perforation of the œsophagus at the site of the growth. It is a risk few patients who fully realised all the circumstances would refuse to take.

Cancer of the stomach, when producing pyloric obstruction and food stasis, requires gastro-enterostomy. The relief is often remarkable; pain disappears, appetite and digestion return and weight increases. The maximum prolongation of life to be expected is only a few months, although in a few cases it has been extended to a year or more. In cancer of the stomach where there is no pyloric obstruction, gastro-enterostomy gives little if any relief (*see* Diseases of the Stomach, Vol. II.).

It has recently been suggested (Moynihan) that a partial gastrectomy is indicated in these cases, not with any expectation of cure, but with the object of ridding the patient of a foul ulcerating mass. In Mr. Moynihan's hands it would appear that the mortality of partial gastrectomy in these inoperable cases has been no higher than that of gastro-enterostomy. It is probable that few surgeons can say the same.

In cancer of the stomach and duodenum when, owing to various reasons, gastro-enterostomy is impracticable, jejunostomy may be performed, but the discomfort of a permanent opening in this position is very great.

Obstructions arising lower down in the small intestine are treated by short-circuiting the bowel above and below the growth, but here again—even in the face of obvious metastases—if the growth be removable, it is justifiable to perform enterectomy followed by end-to-end or lateral anastomosis.

When the small intestine is obstructed near the cæcum the bowel on the proximal side of the growth should be divided and implanted by lateral anastomosis into either the ascending colon (ileo-colostomy) or the sigmoid (ileo-sigmoidostomy).

When dealing with these growths or indeed with any malignant tumour of the bowel it is exceedingly important to remember that for many inches on either side of the growth the mucosa is in a septic and unhealthy condition; division of bowel in this state inevitably results in disaster. A margin of several inches should always be allowed between the edge of the growth and the level of division.

Cancer of the cæcum and ascending colon is treated by ileo-sigmoidostomy. When the transverse colon is affected, colostomy may be possible; failing this the ileum should be implanted in the sigmoid.

In obstruction of the upper part of the descending colon where short-circuiting is impossible, transverse colostomy or cæcostomy should be performed.

Inoperable cancer of the rectum is treated by the ordinary iliac colostomy. There is not the same difficulty in deciding when to perform colostomy as there is in the case of gastrostomy; in fact many surgeons hold the view that colostomy cannot be carried out too early. The relief of pain, diminution of discharge, and the (probably) decreased rapidity of growth which follow the operation, are strong arguments in favour of early diversion of the fæces from their natural channel, where they cannot but have an undesirable influence upon the malignant process. And as the possession of an artificial anus does not in itself unfit the patient for the duties of everyday life, it is probable that early operation is the wisest course.

Exclusion of a portion of the intestine is a procedure not often called for, but in certain cases it serves a very useful purpose. It consists in dividing the bowel on either side of a mass of growth and restoring the continuity of the gut by anastomosis of the proximal and distal ends. The ends of the excluded section of intestine are then brought up to the wound and fixed there. Secretions and discharges now escape upon the surface, but as the growth is no longer irritated by the passage of fæces they rapidly diminish in amount.

This method is particularly valuable when a communication has become established between the bowel and the bladder as the result of carcinoma of either viscus. Exclusion of the segment of bowel in which the fistula is situated obviates the possibility of the passage of fæces into the bladder. The same procedure may be adopted with success when a growth of the intestine has perforated the abdominal wall and caused a fæcal fistula.

At present only those cases have been considered in which a formal operation is possible. Many patients are not seen until acute obstruction has developed, and in these cases detailed investigation of the interior of the abdomen and a lengthy operation is almost certain to be followed by a fatal result. To open the abdomen, under local anæsthesia if need be, and to search for a distended loop of intestine is a matter of a few minutes only. Inserting a Paul's tube and emptying the distended bowel should complete the operation. Further investigation of the case is then deferred until the condition of the patient permits a more extended operation.

In cases where acute obstruction has resulted from carcinoma of the ascending colon or hepatic flexure the simple operation of appendicostomy has given good results.

Respiratory Obstruction.—This may be caused by carcinoma of the larynx, by new growth of the thyroid, or by the pressure of enlarged lymphatic glands, the seat of lympho-sarcoma or secondary carcinoma.

In carcinoma of the larynx high tracheotomy should be carried out. When, however, the obstruction is caused by affections of the thyroid or of the cervical glands, low tracheotomy is necessary. The opening in the trachea should be as low down as possible, as otherwise it may subsequently be blocked by extension of the growth.

Tracheal obstruction is sometimes caused by malignant lymphatic glands or other growths within the thorax. Life may be prolonged a little while in these hopeless cases by opening the trachea low down and inserting a long flexible tracheotomy tube which extends beyond the obstruction (*see also* Diseases of the Larynx and Trachea, Vol. III.).

Urinary Obstruction.—This is caused by cancer of the penis and vulva, by growths of the bladder or prostate, and in cases of cancer of the uterus by extension of the growth to the ureters.

Urethral obstruction caused by growth of the penis or vulva is satisfactorily dealt with by repeated catheterisation. When, however, the inner orifice of the urethra is blocked by vesical or prostatic growth, there is great pain and constant strangury in addition to the urinary obstruction. This can only be relieved by suprapubic cystostomy.

A vesical growth which does not encroach upon the urethral orifice still causes obstruction, because the infiltrated bladder wall cannot properly contract upon its contents: moreover, the perpetual attempts to empty the bladder cause constant suffering. In these cases a permanent cystostomy opening is also necessary. The choice of route, i.e., whether suprapubic or perineal, depends upon the situation of the growth. The opening should be as distant from the growth as possible, both to lessen the possibility of its subsequent involvement and to obviate the irritation of the ulcer by the tube. If the position of the growth renders a choice of route feasible the suprapubic operation should be performed.

Implantation of the ureters in the bowel has been occasionally practised in the treatment of carcinoma of the bladder. The relief obtained is very considerable, but there is great danger of an ascending infection of the kidneys and a fatal termination from pyelo-nephritis.

Obstruction of one ureter is not recognised unless the development of hydronephrosis calls attention to what has happened. When, however, both ureters become closed, anuria declares itself and must be promptly dealt with if life is to be preserved. Treatment consists in opening the kidney (nephrotomy) and allowing the urine to escape upon the loin. It is useful to remember that it is nearly always the left ureter which is first affected; therefore by the time that anuria develops, the corresponding kidney is probably the most extensively disorganised. The right kidney should accordingly be opened first, and if it is in a fairly satisfactory condition there is no need to lengthen the operation by dealing with the other side, as one functional kidney will serve the patient satisfactorily for her short remaining span of life.

Biliary Obstruction.—This may be determined by carcinoma of the head of the pancreas, by new growths of the bile papilla and biliary ducts, or by the presence of malignant glands in the portal fissure.

In all these conditions severe jaundice results. This in itself gives rise to various unpleasant symptoms, while the appearance of the patients is so distressing to themselves and their relatives that an operation for its relief is worth attempting.

When the common bile duct is obstructed, cholecystostomy may be performed and the bile allowed to escape upon the surface. When, however, the patient is in a condition to stand a more prolonged operation, a communication should be made between the gall-bladder and the colon (cholecyst-enterostomy). Needless to say this is the preferable proceeding, although it will cause temporary biliary diarrhœa.

When the gall-bladder is so shrunken that this operation is impossible or when the hepatic ducts are themselves obstructed at the portal fissure, intrahepatic cholangiostomy has been performed. This consists in making an incision or a raw surface in the liver so as to expose bile ducts, and then opening and suturing a loop of jejunum to the raw surface of the liver or to the edges of the incision. This allows the bile to drain away into the intestine.

The serious danger of persistent hæmorrhage after operations on jaundiced patients has already been referred to.

THE RELIEF OF CERTAIN SPECIAL SYMPTOMS.

There now remain for consideration certain special symptoms of great importance.

They are: (1) the brawny arm of breast cancer; (2) spontaneous fractures; (3) hydrothorax and hydroperitoneum.

The Brawny Arm of Breast Cancer.—This terrible complication of cancer of the breast results from the blocking of lymphatic channels either by the growth itself or by the peri-lymphatic fibrosis which accompanies its extension. The only route by which the lymph can then return from the arm is by slow and uncertain percolation of the tissues, and the limb soon becomes an unwieldy bolster-like mass, bereft of the power of movement and the seat of excruciating pain.

The introduction of the operation of *lymphangioplasty* by Sampson Handley marks a great advance in the treatment of this condition.

Lymphangioplasty consists in the provision of artificial lymphatic paths in the subcutaneous tissues of the arm by the introduction of long strands of silk which run upwards from the wrist, to terminate in the healthy tissues beyond the axilla. The operation obviously demands the most scrupulous antiseptic precautions, for if suppuration occur at any point along the lines of silk it will rapidly extend the whole length of the arm and will not subside until the threads have been withdrawn.

For some days prior to the operation the whole arm should be repeatedly scrubbed with soap and water and thoroughly bathed with non-irritant antiseptics. A final application of tincture of iodine is a valuable additional precaution.

The introduction of the threads, which should be of woven tubular silk (No. 12, Mayer and Meltzer), is commenced at the wrist through a ½-inch incision extending well into the swollen subcutaneous tissues. A moderately stiff probe, 10 inches long, is threaded with the silk and pushed through this incision as far as it will go in an upward direction under the skin of the arm. A second incision is then made over the point of the probe, which is seized with forceps and withdrawn, the silk with which it is threaded now occupying the subcutaneous tunnel made by its passage. The loaded probe is reinserted through the incision just made and again forced up the arm. The point is again exposed by a third incision, seized with forceps and withdrawn. The same procedure is repeated until the silk has been carried at least 6 to 8 inches beyond the margin of the infiltrated tissues.

Four threads, conveniently spaced round the limb, should be introduced. The upper ends of the two anterior threads may terminate in the loose tissues of the axilla and anterior thoracic wall. The two posterior threads are carried up behind the shoulder and terminate over the scapular region. When the presence of an ulcer forbids the anterior termination of the threads, they should be carried over the shoulder and spread out over the scapula along with the other threads; but they must be arranged as far apart as possible.

When introducing the silk it is wise to insert a small cannula into the skin incisions and to pass the probe through it in order to avert the possibility of infection of the silk by contact with the skin.

The result of the operation will be disappointing unless attention be given to the subsequent posture of the arm. Gravity must be allowed to assist the lymph in traversing the silken conduits: for some hours daily the arm should therefore be elevated on a cradle splint, in such a position that the hand is above the level of the axilla. A difference of an inch or two may be all that is possible owing to rigidity of the limb, but this will suffice if maintained for several hours morning and evening.

In the majority of cases the results of lymphangioplasty have been strikingly successful; relief of pain is marked and diminution in the size and tension of the arm is extraordinary.

Unfortunately not all cases of brawny arm are suitable for operation. When there is pleural effusion on the affected side it is useless, owing to interference with the lymph flow in the thoracic parietes (Handley); and in cases where pain is largely due to the pressure of growth on the brachial plexus, it is obvious that no relief can be expected. The operation is also contra-indicated when the mammary growth is of such extent that it is impossible to find a sufficiently wide bridge of non-ulcerated skin to carry the threads, or when the whole condition is so septic that infection of the silk is inevitable.

When lymphangioplasty cannot be performed, multiple punctures or small incisions may afford temporary relief by reducing tension.

Removal of the whole upper extremity (Berger's amputation) has been occasionally practised; but inasmuch as the cases in which this is indicated are just such as can be dealt with by lymphangioplasty, *i.e.*, where there is not much growth or ulceration, it is no longer to be recommended.

Spontaneous Fractures.—The so-called spontaneous fractures of cancer invariably result from the replacement of bony tissue by new growth. Fracture may befall a long bone at the site of a primary sarcoma, but it is much more frequently a complication of those forms of carcinoma in which skeletal metastases are common. These are carcinoma of the prostate, thyroid and breast. As the last is infinitely more common than the others, it follows that the vast majority of spontaneous fractures are the result of mammary cancer.

In this affection any of the bones with the exception of those below the knee or below the elbow may become the seat of secondary growth; but it is only the humerus and the femur in which fracture is at all common.

The presence of a metastasis in either of these bones is not often realised until fracture has occurred but should be suspected, especially in cases with numerous subcutaneous deposits, when there is localised pain at the upper end of the femur or the middle of the humerus. A skiagram may then reveal the areas of rarefaction in the bone which indicate the presence of new growth.

When fracture has occurred union is an excessively rare event owing to the extensive destruction of the bone and periosteum that must take place before fracture becomes possible.

Treatment should be directed to keeping the parts immobilised. In the case of the humerus the upper arm may be fixed to the side and the forearm supported by a sling. When the femur is fractured a Thomas's hip splint may be used, but the patient will often be more comfortable if the limb is merely fixed with sand-bags. Fortunately the pain resulting from spontaneous fractures is not often of a very severe character.

Hydrothorax and Hydroperitoneum.—These are common occurrences when primary growths or secondary deposits involve pleura or peritoneum.

Hydrothorax may result from malignant disease of the lung or mediastinum, but its most common cause is the extension of mammary carcinoma through the thoracic parietes and the presence of secondary nodules on the parietal or visceral pleura. The amount of fluid may be very great, and when both sides are affected respiration is seriously embarrassed. Relief is obtained by aspiration, but it is of a very temporary nature, as the fluid rapidly collects again. Patients who have developed hydrothorax rarely live many weeks.

Hydroperitoneum may accompany any form of malignant growth of the abdominal viscera whether of primary or secondary nature. It is treated by paracentesis as soon as the effusion is great enough to cause distress. The fluid invariably returns, but there is no objection to repeated tappings and the patients may sometimes be kept alive for a considerable period.

It is important to remember that many ovarian and uterine tumours of quite simple nature cause hydroperitoneum and that the presence of a large amount of fluid by no means necessarily indicates malignancy. In any case where there is the slightest doubt exploratory laparotomy should be performed.

EMPIRICAL REMEDIES.

Mere enumeration of the countless remedies that have been claimed to relieve or cure cancer would occupy many pages; needless to say in the vast majority of cases the hopes or claims of those responsible for their introduction have not been justified. It will only be possible to refer to those methods of treatment which have been followed by modified success and to certain other methods which for various reasons require special mention.

In order to understand why a remedy, which ultimately proves completely useless, receives the wide publicity and general support that we know is so often accorded to "cancer cures" when they are first introduced, it is necessary to realise certain facts concerning cancer which are often overlooked.

In the first place, clinical diagnosis, particularly of internal cancer, is by no means a matter of certainty. Surgery is an art, not an exact science, and the most experienced are constantly misled. Cases are not uncommon in which an irremovable mass, that has all the appearances of cancer, ultimately disappears. When no treatment of a special nature has been attempted the case is regarded as an example of spontaneous cure, but when some remedy has been used, a new cure for cancer, based on the slender foundation of this one case, is often claimed. In point of fact, these cases are not cancer at all, but have been shown by Bland-Sutton, Mayo Robson and other surgeons, to be instances of actinomycosis, hyperplastic tuberculosis and similar chronic inflammatory affections. It is obvious, therefore, that if a case of cancer is alleged to have been cured, no diagnosis of malignancy can be accepted unless confirmed by the histological report of a skilled pathologist. It will nearly always be found that this most important essential has been overlooked and that no microscopic section is forthcoming.

Again, in the case of quacks and herbalists, ignorance of the natural history of cancer leads them and their patients to believe that the ulceration and disintegration resulting from various applications to a malignant growth is a step in the direction of cure. This accounts for the enormous vogue of caustic and other destructive preparations in the treatment of cancer throughout the ages. Finally, it must be remembered that hope is a powerful tonic, and if a patient becomes aware that he is undergoing a new treatment, especially a treatment of which he has seen glowing accounts in the daily press, improvement in the general condition for the first few weeks is the almost invariable result. No surgeon of experience is misled by this manifestation of auto-suggestion.

The various methods that require discussion may be considered in the following groups: (1) treatment by drugs, applied locally or administered internally; (2) treatment by organo-therapy; (3) treatment by vaccines and serums; (4) electrical treatment; (5) X-ray and radio-therapy.

Drug Treatment.—*Caustics.*—Since the dawn of history cancer has been treated by the local application of caustic drugs. Arsenic, potassa fusa, Fell's paste, chloride of zinc, and more recently, potassium permanganate have all been used. A small and localised growth can be destroyed by the persistent use of any of these substances, but it is a crude and painful method of treatment which is quite unjustifiable.

Great harm is constantly caused in cases of advanced cancer by the application of caustics, for there is no possibility of complete eradication of the growth by this means, and the net result is the formation of an ulcerating chasm which in the ordinary course would not have developed until very much later in the disease.

Preparations of Vegetable Origin.—These constitute a numerous class, of which the following have been most widely used.

Chian Turpentine.—Chian or Cyprus turpentine was introduced by Professor Clay of Birmingham in 1880, and with it he claimed to have cured uterine cancer. It was widely used in this and other forms of malignant disease for many years. Exhaustive and systematic trial at the Cancer Hospital and elsewhere have proved it to be utterly valueless, either in influencing the course of the disease or in relieving symptoms.

Violet Leaves.—In 1901 a lady, aged sixty-seven, who was supposed to be suffering from cancer of the tonsil, completely recovered after the application *to the neck* of an infusion of violet leaves. The case received wide publicity and the method was extensively used throughout the country. Both the local application and the internal administration of an infusion of fresh leaves received fair trial in the wards of the Middlesex Hospital, but proved of no value whatever.

Alder Leaves.—Decoction of the leaves of the common alder (*Abrus glutinosa*) was introduced by Dr. Underwood Gray in 1907 for the treatment of carcinoma and sarcoma. He published many cases in which either cure or considerable amelioration had followed its use. It is administered in the form of ext. albri liq. (Extra Pharmacopœia) in doses of 1 drachm, gradually increased to ½ oz. three times a day. It was tried at the Middlesex and the Cancer Hospitals, but the results obtained were not such as to encourage its continued use.

Synthetic Preparations.—Soamin and atoxyl (proprietary preparations of arsenic which are stated to be non-toxic) have received somewhat extensive trial. In no case was any benefit noted up to the time when administration of the drug had to be stopped owing to symptoms of arsenical poisoning. In one case a few doses were followed by the most alarming cerebral symptoms, and in other instances serious eye affections and even optic atrophy have been recorded.

It does not appear that any case of cancer has yet been treated with Ehrlich's arsenical preparation Salvarsan, but in view of its remarkable effects on the spirochætes of syphilis and similar organisms it is probable that those, and they are many, who hold the opinion that sarcoma is of parasitic origin, will give it a trial in this disease.

Drs. Skene and George Keith recently described a somewhat complicated method of treating cancer by the hypodermic injection of an emulsion of iodipin, arseniate of iron, cacodylate of iron and cinnamate of sodium. They claim that in the majority of cases so treated there has been prolongation of life; and that in a few complete cure has resulted. It can hardly be said that their publications furnish very convincing evidence on this point.

Organo-Therapy.—The treatment of cancer by the administration of extracts of various of the internal organs is presumably based on the assumption that the disease results from the perversion of one or other of the internal secretions. Most of the glands furnishing an internal secretion have had their day.

Thyroid Extract has received very exhaustive trial, both alone and in conjunction with other remedies; but the results which have been obtained do not warrant its continued use.

Placental Extract.—Fichera claims to have caused the disappearance or reduction in size of true malignant growths by the repeated inoculation of human placenta and fœtal tissues.

The use of dried placental extract has been tried in London in a few cases of inoperable cancer, but without benefit. The oral administration of dried extract is, however, a very different matter from inoculation of fresh material, and any expression of opinion on this method of treatment must be reserved until we know more about it.

Thymus Extract.—In view of the rarity of carcinoma in early life Mr. Foulerton suggested that the thymus might exercise an important influence on epithelial growth. He therefore carefully investigated the action of thymus extract on rabbits, and followed this up by the treatment of seven cases of inoperable carcinoma with the fresh glands. An emulsion in glycerine and water of 0·4 gramme of the fresh thymus of a calf was injected subcutaneously, and in one of the cases the result was very striking, the life of the patient being undoubtedly prolonged. This was in 1903, and since that time thymus extract has received fairly extensive trial, but in no instance does it appear that the same careful precautions were observed as to the mode of preparation of the extract. The results obtained by Mr. Foulerton justify further investigation on the same lines.

Oöphorectomy in Mammary Cancer.—The close physiological connexion between the ovaries and the breasts led Sir George Beatson to suggest the possibility of relieving inoperable mammary cancer by double oöphorectomy.

This has now been carried out by himself and other surgeons in a large number of cases, and in a few instances amelioration has certainly resulted, primary growths have diminished and secondary glands have disappeared. In cases where there were metastatic deposits in the viscera, the procedure was found to be useless.

Sir George Beatson gives thyroid extract after the oöphorectomy in the expectation that it will help in the degeneration and absorption of the carcinomatous tissues.

Opinions are divided as to the value of oöphorectomy for advanced mammary cancer. Many surgeons of large experience consider it to be quite useless, but many others think that it is of sufficient value to justify them in putting it before the patient as a possible means of palliation of the local condition and prolongation of life.

A careful survey of the subject leads one to regard this as the fairest attitude, but it is probable that the operation should be reserved for young women with still active ovaries.

As it has been shown that the ovary is a more extensive organ than it appears, considerable care is necessary to make sure of removing all ovarian tissue.

Treatment by Ferments.—The treatment of cancer by the pancreatic ferments, trypsin and amylopsin, was introduced by Drs. Beard and Shaw-Mackenzie, of whom the latter claims priority.

Space does not permit of a detailed account of the reasons which led up to the adoption of this line of treatment.

It was suggested that the subcutaneous injection of a fresh solution of trypsin would result in the disintegration of the constituent cells of a malignant growth, complete absorption of the dead and dying cells being assisted by the subsequent use of amylopsin.

The publication of a series of cases in which cure, or at least great local improvement, was alleged, evoked universal interest. The daily press devoted much space to eulogistic notices of the properties of trypsin, and the medical profession was bitterly attacked for not extending the same enthusiastic welcome to the treatment as had been accorded to it by the friends of those responsible for its introduction.

Controversy raged for many months, but gradually died away after various institutions, in which the method of treatment had received extended trial, had published reports that showed it to be valueless.

Any doubts that may have lingered in the minds of those who thought the various trials of the treatment had not been sufficiently extended, must surely have been finally dispelled by the report published by Dr. Seaman Bainbridge, of New York.

This report deals with the results obtained in a large number of cases of cancer in which the trypsin treatment had received a most thorough and painstaking trial. In no single case was the slightest benefit recorded.

Although the trypsin treatment is useless as a *cure* for cancer, it is not denied that the ferment has a powerful digestive action upon dead and dying tissues, and as already described this property has been taken advantage of by Handley in the palliative treatment of malignant stricture of the œsophagus.

Serum and Vaccine Treatment.—*Doyen's Serum.*—Dr. Doyen, of Paris, regards cancer as a parasitic disease, caused by the micrococcus neoformans, and from this organism he prepared a serum with which he claimed to be able to cure the disease. However, specimens of the serum supplied by Dr. Doyen himself proved quite valueless in this country.

Micrococcus Neoformans Vaccine.—It is an undoubted fact that very many malignant and other tumours become infected at an early stage of their development with a staphylococcus—the micrococcus neoformans—which Doyen claimed to be the specific organism of cancer.

That there is any means of distinguishing this coccus from an ordinary staphylococcus is generally denied, although A. Leitch brings forward strong evidence that it has special morphological characters. In any case neither Leitch nor any other English observer regards this micro-organism as specific for cancer.

Sir Almroth Wright has suggested that it may be in part responsible for the pain, swelling and infiltration in connection with malignant tumours, and perhaps for the cachexia present in the later stages. On these grounds he prepared a vaccine in the hope of relieving these symptoms. However, the results were not encouraging, and micrococcus neoformans vaccine cannot be said to be of any material value.

None the less, as the rôle of micro-organisms in producing many of the secondary effects of cancer is coming to be more fully recognised, it is probable that in the future vaccines will play an important part in the alleviation of inoperable cases.

Otto Schmidt and Adamkiewicz have each been responsible for the introduction of a serum (in the latter case under the name of cancroin). In each instance it proved utterly valueless and requires no further consideration.

Coley's Fluid.—In 1895 the treatment of sarcomata by the mixed toxins of Bacillus prodigiosus and Streptococcus erysipelatis was introduced by Coley. The method has undergone various modifications and improvements, and Coley himself visited this country in 1909 and gave a very clear and convincing account of his experience with the fluid. He claims to have cured 10 per cent. of his cases of inoperable sarcoma, and to have obtained temporary improvement in a large proportion of the remaining cases. Instances of the apparent cure or of great temporary improvement following the use of Coley's fluid in microscopically verified sarcoma have been quite recently published in this country by Spencer, Woodman and Ashdown. An explanation of the small number of cases that has been successfully treated in Great Britain is possibly furnished by the great difficulty in getting active preparations of the fluid. (Dr. Tracey, 5138 Wayne Avenue, Germanstown, Pa., prepares the fluid for Dr. Coley's own use, and has been good enough to supply various surgeons in England.)

The fluid is injected either intramuscularly or directly into the tumour. In either case the initial dose is ¼ min., which should be increased by ¼ min. each day until a well-marked reaction is obtained. This is characterised by a temperature of 101° to 103° F., nausea, vomiting, pain in the limbs and possibly a rigor. Temperature attains its maximum about four hours after the injection and as quickly falls, so that by the next day the injection may be repeated. When the growth itself is injected reaction is produced by a much smaller dose than when the injection is made elsewhere. The quantity of fluid used should not be greater than is necessary to obtain a well-marked reaction. It will be found to vary from as little as 1 min. to 10 or 12 min.

In favourable cases a change will be manifest in the growth at the expiration of two or three weeks.

One of the practical difficulties met with is the severe exhaustion that follows the repeated reactions; in fact the injections may have to be temporarily abandoned on this account.

It is only fair to add that Dr. Coley does not suggest that his treatment should take the place of operation in suitable cases, but he recommends its use in all inoperable and recurrent cases of sarcoma, and suggests that a course of injections should be used after operation in order to minimise the chance of recurrence or metastasis.

In the latter case the dose should only be carried to the point of causing slight muscular pains, malaise and a temperature of 99° to 100° F., and should then be repeated three or four times weekly for a space of two to three months.

Cases of sarcoma of bone have in Dr. Coley's hands furnished the most satisfactory results, including those cases of periosteal sarcoma of the femur, in which amputation is almost invariably followed by recurrence.

It cannot be doubted that Coley's fluid is a remedy that deserves a thorough trial in the treatment of all cases of inoperable sarcoma.

In carcinoma the method is quite useless.

Electrical Methods.—The most important of the electrical methods that have been utilised in the treatment of cancer are ionic medication (cataphoresis) and fulguration.

Cataphoresis consists in conveying the ions of an element into the tissues by the passage of a galvanic current. One pole of the circuit, either positive or negative according to the element used, is neutral, and should be placed in a basin of saline solution. The patient's hand should then be immersed in the basin. The other pole is placed on the surface it is desired to treat, but is separated from it by a pad moistened with a 2 per cent. solution of one of the salts of the element which is to be used. Many metals and non-metals have been experimented with, but zinc appears to have given the most satisfactory results. The salt most frequently used is the chloride.

On the passage of the current the chloride of zinc is broken up and ions of metallic zinc are carried into the tissues so long as the current is passing.

Inasmuch as the ions do not penetrate to any considerable depth, it is obvious that the application of this mode of treatment is very limited, in fact it is practically confined to such superficial conditions as rodent ulcer, although it might possibly be utilised for the purpose of keeping the surface of more extensive lesions in an aseptic condition, for organisms do not grow in the zinc-impregnated tissues.

Considerable pain attends the passage of the current, which should be from 5 to 15 milliampères, and many applications are necessary before cicatrisation of the most superficial lesion can be expected.

On the whole, it would appear that in cancer nothing can be done by ionisation that cannot more rapidly and effectually be accomplished by other methods (radium or carbon dioxide snow).

Fulguration.—The discharge of currents of high frequency and great potential directly upon the surface of a growth is a method that has been extensively employed on the Continent, particularly by Keating-Hart. Great claims were made for it, in fact one observer went so far as to state that fulguration of the primary tumour brought about arrest of the secondary cancerous growth in distant lymphatic glands.

If any such change did in fact occur in any of the cases so treated, it is hardly conceivable that it was in any way the result of fulguration.

The application of fulguration to an ulcerated surface does appear to have the result of diminishing pain and discharge. Further than this, few observers appear to have noted any benefit. At the International Cancer Conference (Paris, 1910) Keating-Hart was the sole supporter of the fulguration method.

It has recently been suggested that some of the results noted after the application of X-rays to ulcerated surfaces are due not to

X-rays at all, but to the secondary discharges that are known to be induced by the apparatus and are really of the nature of fulguration.

Treatment by Irradiation.—Under this heading we have to include treatment by X-rays and by the emanations of radium.

We are not concerned here with the methods of applying these forms of treatment, for they are fully described elsewhere, but rather with the results that may be expected to follow their use.

The unrestrained enthusiasm that characterised the use of X-rays in the treatment of cancer some years ago has now abated, and it is possible to form a fairly just opinion as to the true value of this therapeutic agent.

The present position in regard to the X-ray treatment of inoperable cancer would appear to be as follows: Many surgeons consider them to be useless, some regard them as actually harmful when applied in frequently repeated doses; a few, a very few, have had experience of cases in which apparent cure has followed their application. A critical survey of the subject leads to the conclusion that there is a fair proportion of cases of inoperable cancer in which some amelioration may be expected, either in the direction of the relief of pain or in the cleansing of foul ulcerated surfaces. In a small proportion of cases there are attempts at cicatrisation and the occasional diminution or disappearance of small nodules in the skin or subcutaneous tissue. Further than this no moderate man can promise anything, although it is not denied that an infinitesimal proportion of cases has furnished much more encouraging results than those outlined above.

Breast cancers in which a shallow ulcer or small cutaneous nodules are present, have up to the present time given the best results of all, and in these cases X-rays should not be withheld. In uterine, rectal, lingual or other deep forms of growth, the application of X-rays is a waste of time, unless there is relief of pain. This undoubtedly does occur, when there is no obvious alteration in the local conditions (*see* special article on X-ray Therapy, Vol. III.).

Radium.—The radium treatment of cancer is now going through the same vicissitudes as did X-ray treatment some years ago.

It is however highly probable that it will emerge from this enthusiastic experimental stage with more credit than did its predecessor, for it appears to exercise a much more definite and certain action upon pathological products. Moreover, the agent is so much more easy to apply and to control, that it appears certain that, so soon as suitable quantities can be obtained at a reasonable cost, it will take a very important place in therapeutics.

In such small and localised lesions as rodent cancer apparent cure is so surely and so frequently obtained that many radiologists regard radium treatment as the most suitable method of dealing with this condition. The radium treatment of neoplasms which extend more deeply is at present in its infancy, and much laborious work will have to be accomplished before the treatment of deep-seated growths becomes practicable. Large quantities of radium of high activity will be necessary, and we shall require to know far more than we do at present of the properties of the various screens that are employed to protect the healthy tissues.

Somewhat encouraging results have already been obtained by the method of actually burying small capsules of radium within the substance of a tumour (sarcoma). Shrinkage and ultimate disappearance of the growth has by this means been obtained. Even if complete disappearance is not to be expected much will have been accomplished if an inoperable tumour has been so reduced in size that it becomes possible to deal with it by a surgical operation.

It is probable that the immediate future will see a great advance in radium therapy; larger quantities of the element are now available, and a final decision should soon be possible as to whether any but the most superficial lesions are amenable to the influence of its emanations (*see* special article on Radium Therapy, Vol. III.).

CECIL ROWNTREE.

INFECTIVE DISEASES.

See also Tropical Diseases (Vol. III.).

THE GENERAL TREATMENT OF INFECTIOUS DISEASES.

The private patient who is suffering from one of the infectious fevers should be installed in a large and airy apartment on the uppermost floor of the house, which must be constantly and freely ventilated both by day and by night. Fresh air is not only inimical to the existence of germs, and thus beneficial to the patient himself; but, by diluting the infection which is given off by the sick person, it also diminishes the risk of contracting the same disease which is run by those who attend on him. Even in the case of old and enfeebled persons, abundant ventilation, if the temperature of the air be not too low, can do nothing but good. If the patient complain of feeling cold, he should be given another blanket or a hot-water bottle. A fire is a great aid to efficient ventilation; even in summer a lighted lamp in the empty fireplace will produce sufficient updraught to assist materially in changing the air of the apartment. The temperature of the sick room should be kept at about 56° F. as long as the patient is confined to bed, and at 60° F. when he begins to get up.

The patient ought to be blanket-bathed both night and morning, and if suffering from typhus or typhoid fever special attention should be paid to the prevention of bedsores. Should there be any tendency for the tongue to become dry and sordes to form on the teeth, the toilet of the mouth ought to be performed carefully, as described in the article on typhus fever. A patient who is suffering from extreme prostration should not be allowed to lie altogether on his back, as this position tends to encourage the formation of bedsores and of congestion of the basal portions of the lungs. In a work of this description it is unnecessary to do more than refer to the need for exercising care as to the disposal of all discharges from the body. In scarlet fever, diphtheria, and measles it is the discharges from the nose, mouth, and ears, in smallpox, those from the skin, and in enteric fever, the evacuations, both urine and fæces, which call for special attention (*see* article on Disinfection, p. 161).

Diet.—At the present time it is generally recognised that an individual who is suffering from an acute infectious disease should be given as much nourishment as he can comfortably take without derangement of the digestive apparatus, since it is desirable, not only to maintain his strength, but also to limit tissue waste. The old plan of semi-starvation was responsible for many deaths, and was also the direct cause of many a slow and tedious convalescence. During the acute stage of the illness the diet should consist of fluids only. About 3 pints of milk and 1 of good beef-tea or clear soup is the usual daily allowance for an adult. The beef-tea, unless the patient complain of sore throat, should be well salted, and regarded as a gentle stimulant rather than a food. Should the patient be wasting rapidly, or be taking an insufficient amount of nourishment, the milk may be strengthened by the addition of plasmon, or somatose and lactose. The two first-named are thoroughly reliable proteid preparations, while lactose is especially useful in these cases, for being a carbohydrate, it is a "proteid sparer" and therefore tends to diminish wasting; in addition it is a most valuable and easily digested food. Lactose might be used with advantage in all cases of prolonged pyrexia, a teaspoonful, or more being added to each ½ pint of milk. Occasional feeds may also be given of such patent preparations as Benger's or Mellin's food, while the weakest stomach can digest raw white of egg in the form of albumen water, which may either be flavoured with lemon and sugar, or added to a feed of milk. A diet composed of whey, plasmon and lactose forms an efficient temporary substitute for milk. In the absence of any indication to the contrary, the diet of a fever patient may have solid food added to it as soon as the temperature falls, the tongue becomes moist, and the sick person expresses a desire for something more than liquids. Boiled fish, custard, toasts, rusks and a lightly boiled egg are all very digestible, and, if the patient desire them, are likely to do nothing but good.

Cold water should be given freely to patients with a high temperature. Provided they are taking a sufficient quantity of milk, it is unnecessary to limit the amount of water they drink. It not only makes them more comfortable, but it also acts beneficially by hastening the removal of toxins from the system. Imperial drink and barley-water may also be given and are often acceptable.

Alcohol ought never to be given as a matter of routine in any case of fever. It should be regarded as a drug, and, like other drugs, be used when the need for it arises. Gradually increasing cardiac weakness, general feebleness of constitution, and exhaustion of the nervous system are indications for the exhibition of stimulants. Having decided that alcohol is necessary, the practitioner has next to consider in what form to give it. As a cardiac stimulant, good whisky or brandy will prove adequate. Should the patient be old and feeble, or in a condition of low delirium from exhaustion of the nervous system, the best old brandy, or, failing this, old sherry, may be used with advantage, since the ethers contained in them are of special value in such cases. When there is a tendency to vomit, it is usual to try the effect of a dry champagne, the carbonic acid gas acting as a sedative to the stomach. A certain amount of the gas should be allowed to escape before the wine is drunk, or uncomfortable distension of the stomach may result. Having put a patient on alcohol, the practitioner should take careful note of the symptoms for which it was ordered, so that he may be able to determine whether, or not, the alcohol is doing good. A persistent alcoholic odour in the breath is said to be evidence that the patient is taking too much.

Remedial Treatment.—Apart from the use of curative sera and vaccines, treatment should be directed towards hastening the removal of toxins from the system; to maintaining the patient's strength by an appropriate diet, aided, if necessary, by the use of stimulants; and to the treatment of symptoms which by their undue prominence are a danger to life, or a source of discomfort to the patient. The removal of toxins will be favoured by giving the patient plenty of cold water to drink, while constipation should never be left untreated.

Simple Insomnia is combated by means of hypnotics, of which the safest is, perhaps, chloralamide. But if the skin be hot and dry, and the patient restless, sponging the surface with tepid water will often induce sleep. If sleeplessness be due to pain, Dover's powder, or the solution of morphia hydrochloride, will bring relief. *Headache* is often very marked at the commencement of the illness. A cold application to the head, a small mustard leaf to the nape of the neck, or the administration of such drugs as caffein, phenacetin, acetanilid or antipyrin will diminish, if they do not entirely remove this troublesome symptom.

Pyrexia represents a reaction of the organism to the poison of the disease; any treatment, therefore, which merely lowers a temperature which is not dangerously high, without reducing the amount of toxin in the system, does practically nothing towards advancing the patient's recovery. On this ground many physicians object to the use of antipyretic drugs ; indeed, some observers go so far as to state that such drugs as antipyrin and antifebrin not only fail to do good, but even do harm by depressing the activity of those processes which are concerned with the mechanism of defence. Cold water, on the other hand, lowers the temperature and also assists in the destruction of toxins, besides hastening their removal from the system. It thus exercises a beneficial influence on the course of the disease. The best method of dealing with pyrexia in a particular case will depend on the height of the temperature, the condition of the patient, and the nature of the illness. *Hyperpyrexia,* by which is usually meant a temperature of 106° F. or over, must be treated at once with cold water, the patient being either put into a bath or sponged very freely. It is hardly necessary to say that the hyperpyrexia which occurs in the obviously dying patient does not call for treatment. Temperatures below 106° F., if associated with active delirium, may be treated with cold sponging or the cold, wet pack. When antipyretic treatment is being used at regular intervals during the acute stage of the illness, as it often is in typhoid fever, the cold bath (70° F.) or sponging the trunk with cold water are the most suitable methods to employ. In the eruptive fevers, however, when the temperature is high, the pulse weak, and the rash dusky and ill-developed, cold water should not be used. In such a case sponging the surface of the body with hot water (110° F.) will lower the temperature, stimulate the circulation, and bring out the rash, a result which is always desirable.

F. FOORD CAIGER and H. E. CUFF.

DISINFECTION.

Disinfection is carried out by certain chemical or physical agents known as disinfectants. The term "disinfectant" is commonly applied erroneously so as to include both antiseptics and deodorants. It is well therefore at the outset to define the relationship which holds between them. A disinfectant is some agent, chemical or physical, which by virtue of its inherent qualities will destroy all organisms and their spores, whilst an antiseptic merely inhibits bacterial growth. On the other hand, a deodorant, not necessarily either a disinfectant or an antiseptic, destroys or neutralises odorous gases, either by absorbing the products of decomposition, or by reducing or oxidising them.

The process of disinfection may be carried out in a variety of ways, many of which are only of academic interest and foreign to the scope of this article, hence the subject will be treated from a purely practical standpoint, and only those methods dealt with which are adaptable to everyday practice, easily applied and at the same time efficient and cheap.

Whatever method of disinfection be adopted, special precautions must be taken in the collection and transit of the infected articles to prevent bacterial dissemination. For instance, in dealing with clothes, bedding, etc., it is advisable to provide stout canvas bags, moistened with some antiseptic and securely labelled so as to render identification easy. In the same way close-fitting metal boxes for infected dressings, etc., should be employed, whilst for "dejecta" stoneware vessels capable of being hermetically sealed should invariably be used.

DISINFECTION OF CLOTHES.

(1) Disinfection of Articles of Little or no Value.—*Cremation.* — This is a perfect and rapid means of destroying infected material, dressings, the cheap cotton handkerchiefs of consumptive patients, old pillows, infected mattresses and similar articles. These burn well in a small destructor, especially if saturated with paraffin.

(2) Disinfection of Small Linen and Cotton Goods.—*Boiling.*—Boiling for thirty minutes in a copper is most efficient, and if properly carried out will ensure complete destruction of all microbes and spores. The articles must always be subjected to a preliminary soaking for half an hour in cold water, and then rendered alkaline with washing soda to dissolve the albuminous material; otherwise the albumen will be "fixed" and the articles badly stained.

(3) **Disinfection of Leather and Rubber Goods, Blankets, Books, Etc.** — *Hot Air.* — This method, though fairly satisfactory, is rapidly falling into disuse, chiefly on account of the tardy penetration of the hot air into the clothes and of the risk of scorching and damage by fire. The fabric, too, is apt to rot, and fusible substances such as glue and wax are easily melted. A temperature of 120° C. should never be exceeded, and the exposure should never be less than six hours.

(4) **Disinfection of Wearing Apparel, Bedding, Carpets, Curtains, Etc.** — *Steam.* — The employment of steam under pressure is now almost universally applied for general disinfection. The principle involved is sound, and the disinfectors applying this principle are by far the most efficient, easy to work, and cheap to maintain. Steam under pressure quickly penetrates bulky articles, and very rapidly destroys organisms, spores and lice. As a rule, the articles to be treated are exposed to a pressure of 25 to 30 lb. to the square inch of dry steam, which corresponds approximately to a temperature of 120° C., for twenty minutes. They are then removed quite dry and are ready for use in a very short space of time. The colours do not run and the fabric is not deteriorated or adversely affected.

Speaking broadly, disinfection by steam under pressure has practically supplanted the use of hot air, save for leather and easily fusible goods, such as bound books, glued articles and the like. There are in London and in most of the large provincial towns companies with well-equipped installations, which undertake the work of collecting, disinfecting and distributing clothes, etc., for medical men at a small charge. In nearly all urban and rural districts, on application to the medical officer of health, means are provided for the disinfection of infected goods at the municipal expense.

DISINFECTION OF PREMISES.

(1) **Fumigation** (*a*) *With Sulphurous Acid Gas.*—Until quite recently it was customary to burn 2 lb. of stick sulphur per 1,000 cubic feet in the infected room, after closing all apertures, windows, etc., and allowing twelve hours for the gas to exert its disinfecting action. This is an unreliable and unsatisfactory

method, as it merely insures superficial disinfection, the penetrating power of the gas being practically *nil*. Further, its use materially injures gilt, copper and other metallic surfaces, decolorises many aniline dyes, and rots some fabrics.

(*b*) *With Formalin Gas.*—Formalin gas has to a large extent replaced sulphurous acid gas. It is far more rapid in its action, unattended by any danger to fabrics, and generally more suitable for room disinfection, though its use is not by any means beyond criticism. It may be employed either by utilising a "Trillat" autoclave, or by decomposing small paraform tablets. The latter method is most commonly employed, twenty-five paraform tablets being utilised for every 1,000 cubic feet of space, the period of exposure being six hours. When it is necessary to open up the room the pungent vapour can be readily neutralised by sprinkling a little diluted ammonia solution about the room. The windows can be safely reached and opened if a towel moistened with the same fluid is placed over the mouth and nose. Formalin vapour generated in this way is largely used for books, leather articles, furs, feathers, gloves, etc., which are liable to danger if steam is employed.

(2) **Spraying and Scrubbing.**—(*a*) *Spraying* is employed chiefly for painted and distempered surfaces. It is accomplished by the use of a small hand-spray so arranged that the reservoir containing the antiseptic fluid is stored under pressure in a cylindrical drum and strapped to the attendant's back. The efficiency of this apparatus depends on its ability to deliver a finely divided spray uniformly over a large area. Formalin 1 in 40 strength is usually employed, but a 1 in 200 solution of carbolic acid or a 1 in 100 solution of sodium hypochlorite may be used. The solutions are first sprayed in a horizontal and then afterwards in a vertical direction. (*b*) *Scrubbing and washing* is employed for woodwork, tiling and cemented walls. It is carried out most efficiently by the use of a 1 per cent. solution of chlorinated lime, a large brush being necessary. If wallpapers are to be treated in this way, they should be stripped off and burned whenever possible, and all skirting boards should be taken up before the washing is begun. This is a very efficient and practical means of cheap disinfection, and is especially recommended for the rooms of consumptive patients, as experimentally it has been shown that tubercle bacilli are rapidly destroyed by this means, whereas they are unaffected if a gaseous disinfectant is used.

In Germany and elsewhere it is a common practice to subject the walls, ceilings, etc., to a preliminary rubbing down with bread, collecting the crumbs and cremating them, but the difficulty of the collection of these, coupled by the fact that many find their way into cracks and crevices, makes the method an undesirable one.

DISINFECTION OF STOOLS.

As the stools of patients suffering from enteric and cholera are charged with the respective micro-organisms, rigorous measures must be adopted to destroy the dejecta, so as to prevent any possibility of the carriage of infection. The fæces should be stored in stoneware receptacles, with close-fitting lids, capable of being hermetically sealed. Means should also be provided to ensure thorough sterilisation of these vessels after use. Any one of the following methods may be adopted for the sterilisation of infected dejecta:

(1) Boiling for half an hour under steam pressure.

(2) Boiling for half an hour, the stools being intimately mixed with 1·20 carbolic acid.

(3) Cremation of the stools in a destructor, after adding sufficient sawdust and paraffin.

(4) Cremation of the stools in a destructor, after mixing with ashes and coke.

(5) Intimately admixing with the stools either a solution of 4 per cent. formalin or acid corrosive sublimate (1 in 500), special care being taken that the disinfectant is added in such quantities that it is present in the whole mixture to the amounts indicated.

Methods Nos. 3 and 5 are recommended, as they are easily applied in general practice.

DISPOSAL OF THE DEAD.

The dead body should be wrapped in a sheet, soaked either in 1 per cent. formalin or in 5 per cent. carbolic acid. Both Izal (2 per cent. solution) and perchloride of mercury (1 in 500) are also very satisfactory. Whenever possible the body should be cremated, but if this cannot be carried out the body should be placed in a perishable coffin of unprepared wood, so that the ultimate reduction of the corpse may be facilitated.

DISINFECTION OF BEDROOMS, DURING AND AFTER CONTAGIOUS COMPLAINTS.

The rooms chosen for a case of an infectious nature should be well ventilated, possess a southern aspect, and be kept as free from dust as possible. All ornaments and unnecessary furniture should be removed. The floors should not be scrubbed while the patient is in occupation, and no rugs or hangings should be permitted. All rugs, curtains, carpets, etc., after use should be wrapped in sheets, or placed in large canvas bags, moistened with 1 in 100 Izal solution, and then disinfected by steam under pressure.

Knives, forks, plates and crockery should be placed in a pail containing 1 in 200 Izal solution for half an hour, and then cleaned by boiling. Brushes and combs are best dealt with by soaking in 1 in 100 Izal solution for half an hour, and then washed with soft soap and cold water.

At the conclusion of the illness the paper should be stripped, the ceiling re-whitewashed, and the painted work, if possible, renewed. The room and all its contents should be disinfected under the direction of the medical officer of health.

HAROLD D. SPITTA.

ACUTE ABSCESS.

The treatment of an acute abscess is to open it and to provide drainage. Any further remarks are in the nature of explanations of the procedure involved. When the surgeon is in charge of a case of acute inflammation, one of his chief anxieties must be to watch for the advent of suppuration, and when such has occurred to open the abscess cavity at once. When the inflammatory process is superficial, the recognition of the presence of pus is a comparatively simple matter. When pus formation is taking place at a deeper level more difficulty arises, and in this case it may be necessary to apply fomentations, with a view to hastening and localising the suppurative process, and to deal with this by incision as soon as its presence is noted. When the inflammation is acute, spreading and superficial, incisions may with advantage be made before the advent of suppuration. The condition here, however, is rather one of cellulitis, and reference should be made to the section on that condition.

Before opening the abscess the skin is purified in the usual manner, and the part shaved if necessary. Although it is possible to over-estimate the importance of a double infection in delaying healing after drainage of an acute abscess it is advisable never to omit these preliminaries. The question of anæsthesia must next be considered. Inadequate incision, failure to reach pus or to open up the recesses of the abscess cavity, imperfect provision for drainage—in fact, all the features of failure in abscess treatment—are chiefly dependent upon the surgeon's anxiety to avoid giving pain and the haste engendered thereby. Anæsthesia, either local or general—gas is usually sufficient—is, therefore, advisable in opening all but the most superficial abscesses. In planning the incision the following principles must guide the surgeon :

(*a*) The incision should be large enough to secure the efficient evacuation and drainage of the abscess, but the huge dashing incisions once thought necessary have nothing to recommend them. Two small incisions into different parts of a large abscess may often with advantage replace one large one.

(*b*) The incision is best placed at a dependent part of the abscess cavity.

(*c*) By taking advantage of folds of skin or lines of hair the incision is placed so that the resulting scar may be as little conspicuous as possible.

(*d*) The incision must be planned so that important structures may be avoided.

An ordinary scalpel is plunged vertically downwards until the abscess cavity is reached, and the incision then continued in the desired direction. For superficial abscesses a Syme's knife may be used; the point is inserted into the abscess cavity, which is then freely opened by cutting from within outwards. In the case of deep abscesses, especially where important vessels or nerves are likely to be encountered, Hilton's method should be employed. The superficial tissues only are divided with the knife. A director is then thrust in the direction of the abscess cavity and, when pus escapes, sinus forceps are introduced and the track enlarged by opening their blades. Whilst it is an advantage to remove any loose necrotic masses, nothing is gained by squeezing or irrigating the abscess cavity; scraping of the abscess wall is especially to be condemned, since fresh areas may be opened up to infection, profuse bleeding may be occasioned, and pyæmia even may result. When dealing with a large abscess the finger may be introduced and a gentle exploration of the interior will make sure that free drainage has been secured for all the recesses of the cavity. Drainage is provided for by indiarubber tubes or gauze strips. The former are preferable, and should reach to the bottom of the abscess. The free end is cut almost flush with the skin surface, a sterilised safety-pin being passed through the tube to prevent it slipping out of reach. Gauze strips are employed when a tube cannot readily be retained. They should be lightly inserted, and should drain the cavity, not plug it. The tube is shortened daily as the diminution of swelling causes it to be extruded; but in the case of deep abscesses it should not be removed for three days, by which time a track will have formed and no difficulty will be experienced in replacing it. The period after which drainage may be dispensed with differs with the individual case. Generally speaking, as soon as the discharge has become thin and serous and the local and constitutional signs of inflammation have subsided, the tubes may be removed permanently. Little harm can arise provided that for a day or two longer some part of the external incision be prevented from closing by a small gauze strip. Until the more acute local symptoms have subsided, fomentations of boracic lint or sterilised gauze wrung out of hot water are the best form of dressing. They should be changed three or four times daily. A note of warning may here be inserted as to the danger of carbolic gangrene, resulting from the use of carbolic fomentations. (*See* Gangrene.) After two or three days sterilised gauze dressings will suffice. They are changed daily, or more often if the amount of discharge renders it necessary. Rest in bed, or by the application of splints, slings, etc., is a necessary and frequently neglected part of the treatment of an acute abscess.

Under certain circumstances the favourable progress to recovery after opening an abscess may be interrupted, and appropriate treatment must be adopted:

(*a*) Drainage may be inefficient owing to pus collecting below the level of the incision, and a counter-opening at the most dependent part of the abscess cavity is made by cutting down upon the end of a closed pair of Spencer-Wells's forceps, passed to this point through the original incision.

(*b*) Infection may spread into the neighbouring part from the wall of the abscess, and a spreading cellulitis may result. The discharge becomes scanty and the surrounding tissues swollen, brawny and œdematous. The indications are to increase the general and local resistance of the patient, and to aid the advent of blood with its protective substances to the inflamed part. General constitutional measures are, of course, adopted, and it is here that vaccine therapy and Bier's passive hyperæmia treatment are of the greatest service. A vaccine, prepared from a culture of organisms grown from the pus, is administered, and passive congestion brought about. (*See* Vaccine Therapy and Bier's Treatment, Vol. III.) To favour a flow of serum through the abscess cavity Wright's salt and citrate lotion may be recommended. It consists of sodium chloride (4 per cent.) and sodium citrate (1 per cent.) in sterilised water. Strips of gauze soaked in it are lightly packed into the abscess cavity. Further incisions may become necessary.

(*c*) From various causes the healing of the track resulting from the opening of the abscess may be retarded, and a sinus may result. This condition is dealt with under the heading of Sinus and Fistula.

(*d*) General septic diseases such as septicæmia or pyæmia may ensue. The treatment of these is described elsewhere.

WHITLOW.

A WHITLOW is a septic inflammatory process affecting a finger, usually the result of a wound or abrasion. According to the extent of the tissues of the finger involved in the process, whitlows are classified under four headings. As the distinction between these varieties is of primary importance in treatment, they will be briefly described :

(1) *Sub-cuticular Whitlow.*—In this variety there is a collection of pus beneath the epidermis, which is stripped up from the underlying skin for a variable distance, forming what may be described as a " pus-containing blister." There is but little pain associated with this variety.

(2) *Sub-cutaneous Whitlow.*—The cellular tissue constituting the pulp of the finger is here involved in the suppurative process. Owing to the density of this tissue there is intense pain, and there is likely to be a spread of infection to the deeper structures, giving rise to one of the varieties about to be described.

(3) *Thecal Whitlow.*—In this case the infection has spread to the tendon-sheath and a suppurative teno-synovitis results. The general constitutional symptoms become aggravated, and purulent infection spreads rapidly up the sheath. There is swelling, redness and tenderness over the line of the affected tendons, and the pain, always severe, is increased on movement. The tendon sheaths of the fingers terminate distally at the base of the ungual phalanx, whilst in the proximal direction they reach a short distance beyond the base of the finger into the palm of the hand. In the case of the little finger, however, the synovial sheath is directly continuous with the large palmar synovial sac. This sac, hour-glass in form, begins about 1½ inches above the annular ligament, and passing beneath it terminates at the middle of the palm. The flexor tendon of the thumb has a separate sheath, which reaches from the base of the distal phalanx to a point 1 inch above the annular ligament, beneath which it passes. This sheath may at times communicate with the common palmar sac. Whilst the limits and connections of the synovial sheath will for a time determine the spread of suppuration, very soon pus makes its way through the wall of the sheath or sac, and diffuse suppuration in the palm or amongst the muscular planes of the forearm ensues.

(4) *Sub-periosteal Whitlow.*—Infection spreads beneath the periosteum of the affected phalanx, usually the terminal, which undergoes a greater or lesser degree of necrosis, often associated with infection of the inter-phalangeal joint.

Treatment.—In the earliest stages, before the formation of pus and when there are only inflammatory signs about a cut or abrasion of the finger, boracic fomentations should be applied, and the hand kept well raised in a sling. Bier's hyperæmia treatment is also available; it will, however, save repetition if the subject of Bier's treatment as applied to whitlow is considered as a whole in the article on that subject. If in spite of the measures described the disease progresses, or fails to improve, an incision should be made. In the *sub-cuticular* form the raised cuticle is insensitive, and may be cut away with scissors as far as its attached margin. The finger is then soaked for a few minutes in biniodide of mercury (1 in 4,000) and boracic fomentations are applied. As soon as the inflammatory condition shows no tendency to spread (twenty-four to forty-eight hours of moist applications usually suffices), a dry dressing is applied, and healing is rapidly complete. Any spreading should be treated by clipping away more cuticle and disinfecting the underlying edges. In the *subcutaneous* form a free incision, deep enough to open the finger pulp thoroughly and large enough to allow of removal of sloughs, is made without delay. This incision is made on the palmar aspect of the finger, passing through the most tender point, the greatest care being taken to avoid the tendon sheath or periosteum. It is not too much to say that the disastrous results of whitlow are largely due to the hasty and inefficient evacuation of pus caused by the surgeon's nervousness and anxiety to avoid giving pain. Anæsthesia is, therefore, advisable and general anæsthesia (gas is sufficient as a rule) is preferable to local. After incision a small gauze wick is inserted, and boracic fomentations are applied and changed every four hours. Carbolic fomentations are inadvisable because of the danger of gangrene following their use. (*See* Gangrene.) The hand may be soaked in a bath of antiseptic solution when the dressing is removed. This system of hot dressing is to be discontinued as soon as the inflammatory process shows no signs of further spread; prolonged maceration by wet dressing and baths is one of the causes of delay in healing. Movements of the finger, active and passive, are begun at the same period.

When the tendon sheaths are invaded and an *acute suppurative teno-synovitis* develops, the case assumes altogether a more serious aspect. Without delay the affected sheath is opened. In the case of the index, middle and ring fingers these incisions should be placed over the proximal and middle phalanges. They should be made about ¾ inch long, and should be placed laterally in pairs so as to enter each side of the tendon sheath. These incisions, while providing equally good drainage, do not cause such a wide gaping and exposure of the tendon as do single mesial incisions, and the vitality of the tendons is less endangered.

Small tubes, split longitudinally, or gauze wicks are inserted and fomentations are applied. In the case of the little finger an additional incision is necessary, following the line of the distal half of the fifth metacarpal bone. In the case of the thumb the sheath is opened by two short incisions, which enter the lateral aspects of the tendon sheath over the middle of the proximal phalanx. Another incision is made along the inner margin of the thenar eminence. The muscles are retracted outwards, the sheath found between the flexor brevis pollicis and the adductor obliquus pollicis, and carefully opened by a lateral incision. If the upper end of the sheath has become involved, as evidenced by swelling and tenderness above the anterior annular ligaments, a careful dissection is called for to drain the sheath in this position. Under general anæsthesia an incision is made just to the ulnar side of the flexor carpi radialis, avoiding the sheath of that tendon, which is retracted outwards. The palmaris longus is pulled inwards, and the sheath of the flexor longis pollicis is found lying deeply between the two, with the median nerve close to its inner side under cover of the palmaris longis. Split drainage tubes are employed as before. By early incision, as described, it is usually possible to avoid infection of the sheath of the common flexors; but if delay takes place, not only this, but also the flexor carpi radialis sheath and the inter-muscular planes of the forearm will rapidly become involved. When the common palmar synovial sac is involved, it is to be opened above and below the annular ligament. For the former purpose the incision is placed close to the inner side of the palmaris longus tendon; for the latter the vertical incision is made just to the ulnar side of the middle of the palm, commencing behind the line of the superficial palmar arch (a horizontal line level with the web of the outstretched thumb), and passing upwards for 1 inch. The skin, subcutaneous tissue and deep fascia are divided, and a closed pair of forceps is thrust on until pus is encountered, when separation of the blades will provide a free opening. Split drainage tubes are inserted. Extension of the suppurative process to the forearm must be met by free incisions in suitable positions. In all cases as soon as the active spread of inflammation is at an end, movements of the fingers are begun and persevered with.

When the *periosteum* is affected and pus collects between that membrane and the bone—an event almost limited to the terminal phalanx—a free incision is made down to the bone, and the subperiosteal collection is drained. Necrosis of the phalanx is apt to occur, and when the dead part is loose it may be removed.

Such an event as this will often call for amputation on account of a useless and painful extremity to the finger; but it should be the rule to avoid amputation during the continued inflammatory process. Much more tissue than at first appeared likely may thus be saved, and amputation may be deliberately planned with a view to the best functional results, without the necessity of considering the possible spread of sepsis to the stump.

MAYNARD SMITH.

TUBERCULOUS ABSCESS.

THE treatment to be adopted for a tuberculous abscess varies considerably with its position, size, and freedom or otherwise from secondary infection. The methods of treatment to be employed will, therefore, be described together with the types of abscess for which they are suitable.

(1) The ideal treatment is without question the complete excision of the abscess and its wall intact, in the same way as one would excise a sebaceous cyst. This should always be done when the position and size of the abscess permit. Small subcutaneous tuberculous abscesses, such as are common in children (*gomme scrofuleuse*), may readily be dealt with in this way. Abscesses arising in connection with tuberculous cervical glands may also be similarly treated, the affected gland being taken away in one mass with the abscess. Moreover, when the abscess originates from a carious patch of bone, the same treatment is feasible, provided that the bone is accessible and that the relation to the abscess permits. When the abscess wall has been freed as far as its attachment to the bone, a chisel is made to cut through the healthy zone of bone sufficiently clear of the carious portion. An abscess resulting from tuberculous caries of a rib forms a good example of this. When the skin is thin, undermined and unhealthy over the presenting part of the abscess, an elliptical incision is made through the healthy adjoining skin so as to enclose the affected part. When the excision is complete, the muscles and fascia are brought together by fine catgut sutures, and the skin completely closed with silkworm gut. If the abscess cavity is accidentally opened during the procedure, the escaping pus is washed away by a stream of hot saline lotion, and the operation completed as before. If removal of bone is called for, an inspection may show that there is still disease remaining beyond the point of section; this is dealt with by scraping with a sharp spoon, and complete closure carried out. Almost invariably this method of treatment gives healing by first intention and a permanent cure.

(2) When the deep connections and anatomical relations of the abscess cavity render the method just described impracticable, the abscess cavity is to be evacuated by an aspirator and washed

out, the puncture being afterwards closed. The skin is carefully cleansed, and under local anæsthesia the blade of a narrow scalpel is pushed through the skin vertically, making an incision not more than ⅛ inch in length—healthy skin over an accessible part of the abscess should be selected. An ordinary aspirator, such as is used for tapping a pleural effusion, is taken, and a large-sized needle is thrust through the skin puncture into the abscess cavity. The trocar having been withdrawn, the abscess contents are sucked out into the aspirator bottle as completely as possible. If the needle becomes blocked, it should be cleared by passing a stylet down it. The tube of the aspirating bottle is taken off and the tube of an irrigator is attached, and the cavity filled with normal saline lotion at a temperature of 105° F. This is drawn off by the aspirator, and the process repeated until the fluid returns clear. The needle is withdrawn. A single fine suture closes the skin puncture, which is then sealed with collodion. Pads and bandages are put on to approximate the abscess wall. Sometimes a single tapping is effectual, sometimes the process must be repeated two or three times. If after repeated tappings the cavity again fills with fluid, the line of treatment next to be described is followed. The advantages of aspiration are great. The likelihood of infection or sinus formation is reduced to a minimum. A complete cure ensues in a fair number of cases, and even if this favourable result is not obtained, the subsequent open operation is far more likely to achieve success. That this is so clinical experience leaves no doubt in the writer's mind, and theoretical investigation amply bears out this conclusion. Wright has shown that the antibacterial properties of a collection of tuberculous pus are very low; sometimes, indeed, they are absent. At the same time those of the patient's serum are often above normal. After tapping, therefore, the wall of the abscess becomes flushed with fluid of high anti-bacterial power, and a subsequent operation deals with tissues which contain fewer organisms, and are moreover better fitted to deal with them.

(3) When aspirations have failed, a general anæsthetic is administered, and an incision 1½ inches long is made into the abscess cavity. The contents are allowed to escape, and the interior of the cavity is systematically scraped throughout with a scoop. There is no necessity to use any force; indeed, when important structures border on the cavity—the peritoneum and iliac vein, for instance, in the case of a psoas abscess—such use would be fraught with danger. All that is aimed at is to remove the lining membrane of tuberculous granulation tissue. At this stage

recesses of the abscess cavity must be carefully looked for, and dealt with in a similar manner, their connections with the main cavity being enlarged if necessary. A large superficial abscess may be merely the result of a caseous gland beneath the deep fascia, the connection being by means of a small hole in that fascia. The superficial loculus, again, may be connected by a narrow devious passage with a deeply placed area of diseased bone. Should this latter be present, it must be removed as completely as possible by means of a sharp spoon. The cavity is now irrigated with hot normal saline lotion until no further *débris* comes away. Scraping and irrigation may be carried out simultaneously by means of Barker's flushing spoon. The walls of the cavity are now thoroughly rubbed over with sterilised gauze swabs on holders, in order to remove any shreds still adherent. These three processes of scraping, irrigation and swabbing are to be repeated until no more tuberculous material is brought away. The cavity is then dried, and the external wound completely and accurately closed. In the case of deep-seated abscesses, buried sutures may be put in to bring together muscular or facial planes. It is essential, however, that these sutures should be readily absorbable.

When treated in this way a large proportion of cases heal by first intention, and permanent cure ensues. Sometimes, however, this favourable termination is interrupted. The cavity re-fills and the operation must be repeated, the wound being closed as before. In other cases the wound gives way and a sinus results. In this case an elliptical incision is made enclosing the orifice of the sinus, which is dissected away, and the deeper part of the cavity having been scraped and irrigated, the external wound is again completely closed. In other cases, again, the abscess cavity may become infected with septic organisms. Free drainage must immediately be provided for, tubes or gauze inserted, and an attempt made by irrigation of the cavity with weak antiseptics and careful dressing to restore it to a healthy condition and obtain healing from the bottom. A long and tedious convalescence is to be expected, with all the dangers associated with septic absorption. When the more acute inflammatory stage has passed, and there is now a sluggish track discharging pus and showing no signs of healing, an attempt may be made by scraping out the cavity, swabbing over the interior with pure carbolic acid or zinc chloride (40 gr. to 1 oz.), and afterwards packing with gauze, to hasten its healing. The results of this treatment are not very satisfactory; sometimes fresh paths of infection are opened up, and severe septic complications follow upon an extension of the suppurative process. Recently an emulsion of bismuth has been used for injection into chronic tuberculous sinuses, and success is claimed for the method. If employed the danger of poisoning is to be remembered, although it is said that the use of the carbonate instead of the nitrate avoids this complication, which is due to nitric acid derivates and not to bismuth.

(4) When a secondary infection has already taken place before the case comes under treatment, and the abscess is pointing at an area of thin, unhealthy, undermined skin, it must be freely opened, the contents evacuated and drainage provided. The subsequent treatment is carried out on the same lines as for a tuberculous abscess cavity infected after operation.

A description of the treatment of tuberculous abscesses would be incomplete without reference to vaccine-therapy. The use of vaccines made from organisms cultivated from the discharge from the sinus has often proved of the greatest value. In cases where infection has taken place with organisms other than tubercle, attempts are first made to get rid of the secondary infection, whilst careful dressing as far as possible prevents the access of other organisms. In order to encourage the free discharge of blood fluid from the sinus, Wright is in the habit of using a salt and citrate lotion. (*See* Acute Abscess.) Apart from the question of secondary infection, tuberculin is of great assistance in dealing with tuberculous abscesses; but its use is ineffectual unless it is combined with the removal of the inert mass of tuberculous material by aspiration or incision.

MAYNARD SMITH.

ACTINOMYCOSIS.

Actinomycosis is a disease caused by the ray-fungus or actinomyces, a streptothrix organism. It is now recognised, however, that many of the affections which are clinically grouped as actinomycotic are due to various forms of streptothrix allied to but not identical with the actinomyces proper. This fact should be carefully borne in mind in the pathological investigations of a suspected case, and it may explain the great differences observed in the reaction to medical treatment. There are two clinical groups of cases: (1) Those in which the disease is superficial, and (2) those affecting the viscera. In the first group surgery can very largely be employed and a cure is possible. In the case of visceral actinomycosis, however, the outlook as regards recovery is very gloomy. Whether earlier diagnosis and more energetic treatment on the lines suggested below will afford better results remains to be seen.

Surgical Treatment.—This should be the first line of treatment whenever possible, as soon as a positive diagnosis has been made. In the superficial lesions removal of the diseased tissues by scraping or excision usually gives satisfactory results and may be all that is required. If all the diseased tissue cannot be removed or the operation amounts to the draining of an abscess resulting from deep-seated disease additional measures may be required. Secondary infection by pyogenic organisms not infrequently occurs and should be treated in the ordinary way.

Local Treatment.—If all the diseased tissue cannot be removed by operation local treatment by biniodide of mercury solution may be employed. When possible the diseased area may be soaked in a bath for five minutes in a warm solution of this drug in the strength of 1 in 1,000 to 1 in 4,000, and then in a boracic bath for a further ten minutes. This should be done once or twice daily. If soaking in a bath is not practicable compresses of the biniodide solution may be applied, taking care not to irritate unduly the surrounding skin. Sinuses may be syringed out with the same solution, provided that care is taken not to leave any of the solution behind.

General Treatment.—The patient should be placed under the best possible conditions as regards food, fresh air and personal hygiene. The tissues of the human body are inimical to the growth of the fungus, and measures of this kind, therefore, may be of considerable importance.

Medicinal Treatment.—The only drug on which reliance can be placed is iodide of potassium. There is increasing evidence that many patients are benefited and some entirely cured by the employment of this drug. It must, however, be given in increasing doses and in many of the cases improvement does not commence until a very large dose is being taken. I have on several occasions given drachm doses thrice daily and sometimes double this amount, and not until these very large doses have been reached has improvement set in. Doubtless these large doses are liable to cause unpleasant symptoms, but in the cases in which I have employed them the drug has been tolerated perfectly well. Other drugs have been recommended, such as oil of eucalyptus.

X-rays have been used, but in my experience neither these nor radium have led to satisfactory results.

W. H. MAXWELL TELLING.

ANTHRAX.

This is a comparatively rare disease in man, though it occurs epidemically amongst sheep and other animals. It is communicated to the human subject either directly through the skin, or indirectly through the respiratory or intestinal tract. In each case the disease is due to the bacillus anthracis.

Cutaneous Anthrax (Malignant Pustule) is most commonly observed on the face, hands, neck or back, and occurs as a result of direct inoculation of the organism or its spores into the cutaneous surface. Within twenty-four hours a small red and painful pimple appears. This rapidly passes from the vesicular to the pustular stage, and is associated with an unusual amount of local congestion, œdema and pyrexia. On the fourth day central necrosis of the pustule takes place, and at the same time a characteristic ring of small red-currant-like vesicles appears. The discharge from the central area contains the specific bacillus, which can readily be identified.

Respiratory Anthrax (Wool-Sorter's Disease).—This is due to the inhalation of the spores of the organism, and is associated with a lesion, usually at the lower part of the trachea. The bronchial mucous membrane becomes swollen and œdematous, but there is little necrosis. The mediastinal and bronchial glands become greatly enlarged, the temperature is elevated, and the patient dies with severe pulmonary embarrassment. Little can be done in the way of treatment. The condition is almost always attended with fatal results within a week.

Intestinal Anthrax.—This condition is due to the ingestion of anthrax spores, and is a very rare condition in man. The lesion in the intestinal mucous membrane closely resembles the condition associated with pulmonary anthrax. The mesenteric glands are hard and swollen ; the patient rarely, if ever, survives.

Treatment.—In cutaneous anthrax the pustule should be excised and the affected area swabbed over with carbolic acid (1 in 20). If the nature of the disease is recognised at an early stage Sclavo's anti-anthrax serum[1] should be given a trial. Its use is often attended with good results and may render surgical treatment unnecessary. No harm can accrue from its use. The rise of temperature which almost invariably occurs after each dose should give no alarm. In cases of malignant pustule from 30 to 40 c.c. of the serum are injected subcutaneously into the flank, and the dose repeated again after a lapse of twenty-four to forty-eight hours. If the case is a very severe one Sclavo recommends the intravenous injection of 10 c.c. of the serum in addition to the subcutaneous inoculation in the flank. The serum should be kept stored in a dark place in the ice chest, and be used as fresh as possible.

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[1] This may be obtained from Messrs. Allen & Hanbury, Vere Street, W. (Tel. 628 Padd.).

Methods of Examination.—In cases of suspected malignant pustule a small quantity of purulent discharge from the central pustule, or some of the vesicular fluid, should be collected on a sterile swab and sent to a competent bacteriologist for cultural examination. It is useless to examine the blood, as the disease in man does not become a septicæmia except in a small number of severe and fatal cases just before death.

HAROLD SPITTA.

CELLULITIS.

In the great majority of cases of cellulitis a definite wound or abrasion may be found which has given entrace to the causative organisms. It is obvious, therefore, that the proper antiseptic or aseptic treatment of such wounds would have avoided the serious complication under consideration. More especially is care called for on the part of those who in their everyday work are continually exposed to the attacks of virulent pathological organisms. Many valuable lives have been lost amongst the members of our own profession from septic diseases acquired in the operating theatre, the post-mortem room, or the surgical ward. Some, at any rate, of these might well have been saved by prompt attention to the wound caused by infected instruments, or by proper protection of simple cuts and abrasions when dealing with such cases as would provide a source of infection. This prophylactic treatment is of the highest importance, and is commonly neglected. Other cases of cellulitis may be avoided by the early recognition and treatment of septic complications ensuing in accidental or operation wounds. The removal of sutures, the insertion of drainage tubes and application of fomentations will often cut short a septic process which, allowed to continue, would result in a widespread cellulitis threatening the patient's life.

In early cases of cellulitis the affected part is kept at rest. Boracic fomentations are applied, a purge is administered, and attention is paid to the general health of the patient. If in spite of these measures the inflammatory process spreads and the tissues become tense, brawny and indurated, no time should be lost before adopting more vigorous measures. Free incisions are made into the inflamed tissues ; where the sub-fascial tissues are involved the fascia is freely divided. These incisions should be made with due regard to the anatomical arrangement of the part, being planned to avoid important structures. Each incision should be about 2 inches in length. Where definite loculi of pus are encountered, drainage tubes are inserted ; otherwise the incisions are lightly filled with antiseptic gauze (cyanide or iodoform) and large moist dressings are applied. Boracic fomentations are as serviceable as any form of dressing, and strong antiseptics are to be avoided. When an extremity is affected the part may be immersed in a bath of boracic lotion, or of sterilised water with tincture of iodine added. A bath of suitable shape is taken, and the edge of this is well padded where the limb rests against it. The lotion in the bath is maintained at a temperature of 100° F. by constantly running in fresh lotion, whilst emptying away the lotion used by means of a syphon tube or by the tap with which a properly made bath is fitted.

Constant irrigation with similar lotions may be provided for by allowing the lotion to flow over the wound from a tube, the end of which is laid on the surface of the wound; the flow should be very slow, and lotion should never be allowed to drop on the wound from a height, as the pain produced thereby could not be tolerated. The dressings are changed frequently, and sloughs are removed as they form. Further spread of the infected process calls for fresh incisions without delay. In some cases, in spite of this treatment, the incisions remain dry and unhealthy looking, the discharge is thick and scanty, and the constitutional symptoms show no sign of abating. Bier's hyperæmic treatment, the bandage being left on for two periods of ten hours in each twenty-four hours, may be employed. Wright's salt and citrate solution is sometimes of great service. It is composed of sodium chloride (4 per cent.) and sodium citrate (1 per cent.) in sterilised water; strips of gauze wet with it are placed in the wound. As soon as the condition begins to subside the fomentations are replaced by dry dressings, and the treatment afterwards is that applicable for granulating wounds.

Constitutional Treatment is of great moment; stimulants are called for, and brandy is one of the most valuable. Quinine and strychnine may be administered, or ammonia and nux vomica combined. The diet should be fluid, and beef-tea and meat extracts, milk and beaten-up eggs should be given in small quantities at frequent intervals.

Vaccine Treatment.—Streptococci or staphylococci are the organisms most often found, and in the former case a culture should immediately be made from the pus, and the appropriate vaccine thus prepared from the patient's "own" streptococci. Pending the preparation of this vaccine, an inoculation may be given of a stock vaccine consisting of a mixture of many strains of the organism. In staphylococcal infections it is not so important to prepare a special vaccine, and a stock vaccine may advantageously be employed (*see* Vaccine Therapy, Vol. III.).

Anti-streptococcal serum has been employed, but the statements of different observers as to the results obtained are conflicting, and on the whole not encouraging.

LUDWIG'S ANGINA.

Cellulitis of the tissues of the neck is not uncommon, and possesses importance from the danger of the rapid spread of infection beneath the layers of the deep fascia. The treatment, as a whole, does not differ from that of cellulitis in general, but individual notice is demanded for Ludwig's angina. This is an infection of the contents of the sub-maxillary region, and arises as a rule from streptococcal infection through some small ulcer in the floor of the mouth. The tissues of the floor of the mouth become hard and brawny, a rapidly spreading indurated swelling appears beneath the chin, spreads down to the hyoid bone, and laterally to the side of the neck. The tongue is pushed up and protruded from the mouth or pressed against the palate, obstructing breathing and swallowing. The tissues about the upper aperture of the larynx become swollen, and œdema of the glottis may develop and cause suffocation. Toxæmia is intense and a fatal result may follow. Free incisions should be made immediately. The knife is entered in the middle line, and the incision carried down to the hyoid bone and deepened until the brawny tissues have been completely divided. The incision should stop short of the mucous membrane, to avoid opening the cavity of the month. If the incision is kept to the middle line, no important structures will be encountered, and the knife may be used boldly. When the swelling is at the side of the neck, appropriate incisions are made, and, the deep fascia having been divided, the inflamed tissues are opened up by pushing into them a closed pair of forceps and opening the blade.

The local treatment of the wound and the constitutional treatment are the same as for cellulitis generally. Any infective process in the mouth is treated by hydrogen peroxide, and if a carious stump is responsible it is extracted. The onset of œdema of the glottis calls for tracheotomy; the septic condition of the mouth renders intubation unsuitable.

AXILLARY CELLULITIS.

This arises usually as a glandular infection from lesions of the hand, and is a common accompaniment of operation and post-mortem wounds. The infection, limited at the first to the axillary glands, spreads beyond their capsule and travels far and wide amongst the planes of cellular tissue. Early incisions must be made. In the first place a free cut is made vertically downward on the inner wall of the axilla midway between the anterior and posterior folds, the blade of the knife being directed towards the chest wall. This incision avoids the long thoracic artery which is under cover of the anterior fold of the axilla, the subscapular artery which lies upon the posterior boundary of the space, and the main axillary vessels and nerves which occupy the outer wall.

It may be necessary to open the space between the pectoral muscles. This is done at the lower and outer edge of the pectoralis major, and at the interval between the sternal and clavicular portion of the same muscle. From this latter incision a blunt instrument, made to penetrate the costo-coracoid membrane, will open the upper limits of the axilla. Incisions along the upper margin of the clavicle to open the supra-clavicular triangle may be called for before the spread of the inflammatory process can be checked. In all these positions the surgeon must have a clear idea of the anatomical relations of the part, and the procedures called for are deliberate dissections to reach areolar spaces definitely aimed at, rather than haphazard incisions in the hope of chancing upon pus.

MAYNARD SMITH.

CHICKEN-POX.

Of all the infectious diseases chicken-pox is certainly the mildest, and the least important. Its mildness is such that a large proportion of cases are unrecognised even by intelligent people, who generally talk of the malady as "a few spots on the skin," and are only awakened to the fact of its being something more by other children, for it is essentially a child's disease, developing similar spots. The malaise is so slight that often the only symptom is a slight backache or headache, the appetite is good or slightly impaired, and the child is therefore thought to have its "liver out of order." The quite unnecessary "dose of oil" or "seidlitz powder" which the mother administers "puts the child right" in a day or two and the disease is over. If such a case as this is seen by a physician during the development of the characteristic spots, except for keeping the child in bed, more as a preventive of infection than for any other reason, no medicine or treatment is necessary.

A few cases are of a severer type, and some develop slight fever; the temperature may range from 100° to 101° F. for forty-eight hours, necessitating a complete rest in bed, and perhaps a febrifuge such as the following: ℞. Sp. Ætheris Nitrosi, ʒij; Liq. Ammon. Acet., ʒij; Aq., ad ℥vj; M.ft. *Sig.*: $\frac{1}{12}$ part every three hours.

Abstinence from solid food is necessary during the fever, and a slight laxative if there is constipation. These cases seldom last more than four to seven days, convalescence is rapid and recovery complete in a week or ten days.

A severe, almost malignant form is occasionally met with, in which there is high fever from the first; the temperature rises to 103°—104° F., the pulse is rapid, 100 to 120 per minute, there is great headache, mostly frontal, a coated tongue, prostration, loss of appetite, and all the usual accompaniments of an acute febrile attack. The spots are very numerous on the shoulders, back and chest, sometimes on the face, and some are found on the arms and thighs. They may be of the typical form, characteristic of the disease, but the disease is apt to simulate smallpox. These cases cause anxiety not only from their severity, but from the difficulty in diagnosis to the inexperienced, so seldom are they seen and so infrequent has smallpox become. If, however, the true characteristics are carefully noted and compared with the true characters of smallpox, mistake can never arise. Each disease is true to its type and never merges into the other.

The treatment is quite simple, but in addition to a febrifuge mixture, salicin, aspirin or phenacetin may be administered in 2 or 5-gr. doses (according to age) in order to relieve the severe pain. To those who are old enough to take it a 5-gr. Dover's powder is comforting and tends to make the skin act, to relieve restlessness and to produce sleep. The fever may last from three to four days, seldom longer, but generally begins to abate after twenty-four or forty-eight hours, and then the disease gradually gives way to a somewhat slower convalescence than in the milder cases.

During this stage a tonic will be necessary and sometimes change of air. Iron is often indicated owing to a slight amount of anæmia produced by the fever. For very young children a teaspoonful of Syr. Ferri Phos. Co. three times daily after meals, serves as a good tonic, and if the appetite is bad, it is useful to add 1 or 2 min. of tincture of nux vomica to each dose. For those who are older, say from eight to fifteen, the following medicine will be found efficacious and not unpalatable: ℞. Liq. Strychnin., ♏30; Tr. Ferri Perchloridi, ♏36; Glycerin., ʒij; Sp. Chlorof., ʒij; Aq., ad ℥vj [U.S.P. ℞. Strychnin. Hydrochlor., gr. $\frac{3}{10}$; Tr. Ferri. Chlor., ♏27; Glycerin., ʒij; Sp. Chlorof., ʒjss; Aq., ad ℥vj]; M.ft.; "$\frac{1}{12}$ part in half a wineglass of soda-water after meals, two or three times daily."

Prophylaxis.—If spread of the disease is to be avoided, children must be isolated from others as soon as there is any evidence of the disease. Simple isolation is generally sufficient if practised early. The attendant should not mix with the other children and a carbolic sheet may be kept over the door of the room.

There are seldom **complications** of this disease, with the exception of the sore throat which sometimes is felt when many vesicles develop on the palate. It requires no special treatment.

H. A. DES VŒUX.

DIPHTHERIA.

General Management.—The all-important point in the general management of this disease is rest, not in the sense in which this expression is generally used in cases of acute illness, but *absolute rest* in the recumbent position. If the patient is a child, and the attack a severe one, he must do nothing for himself, but must allow the nurse to feed him, to place him on the bedpan, turn him in bed, and in fact do everything for him. It does not matter how well he looks or feels; his heart may be so weakened by fatty degeneration of its muscle that the slightest strain on it may prove fatal. The risk of cardiac failure is especially imminent during the second week of the illness.

If the attack is moderately severe, the patient should at first be allowed to have only one pillow. A second may be added at the end of a fortnight, if the condition of the heart is satisfactory, and a week later the patient may be propped up in bed. Towards the end of the fourth week he should be able to sit up in bed, and after a few days be moved from his bed on to a couch or deck chair, provided no paralytic or cardiac symptoms have appeared. Some relaxation of these precautions is permissible with adults and purely tonsillar cases in children. On the other hand, a patient who has had a large amount of membrane and nasal discharge is unlikely to leave his bed for six or eight weeks or even longer, since he is almost certain to have symptoms of serious heart weakness, and probably one or more of the paralyses associated with diphtheria. Nasal discharge should always be regarded seriously, even though the fauces are but slightly affected, and for such patients the recumbent position should be strictly enforced for at least the first two weeks of the illness.

If the attack be one of hæmorrhagic diphtheria the need of caution is, if possible, even greater, and the patient must be very carefully handled, as bruising is easily produced. It is sometimes possible, indeed, to see where the tips of the nurse's fingers have pressed on the patient's skin.

Duration of Isolation.—Putting on one side the question of physical fitness, it would seem to be obvious that bacteriology alone can decide when a convalescent diphtheria patient may with safety be discharged from isolation. Statistical evidence, however, does not support this view. Meadows Turner, in his report on "return cases" in connection with the hospitals of the Metropolitan Asylums Board, gives figures showing that 7,673 recovered diphtheria patients, discharged from hospitals at which the bacteriological test was employed before patients were allowed to go home, had an infectivity rate of 1·13 per cent., while 5,842 patients discharged from hospitals where this special examination was not made had an infectivity rate of only 1·02 per cent. These figures certainly do not favour the view that it is wrong to allow a diphtheria convalescent to mix with the general public before he has been shown on the authority of bacteriological examinations to be free from the Klebs-Loffler bacillus. Should the practitioner decide to rely on this test, the patient should be detained until at least two, and preferably three, consecutive cultures have given negative results. If the bacilli persist for any length of time after the patient is otherwise fit for discharge their virulence should be tested. If proved to be non-virulent, the patient may be discharged. Such persistence is likely to occur in children with adenoids and large tonsils, conditions which hinder the elimination of infection. The nasal passages are especially prone to harbour bacilli for protracted periods, but these are frequently found to be devoid of virulence.

If no bacteriological examination is made prior to discharge adults should be detained until at least three weeks have elapsed since the disappearance of the exudation, while children, even though the attack may have been very mild, should be isolated for a week longer. These must be regarded as the minimum periods of detention for diphtheria; they are only applicable to cases in which the fauces are sound and the nasal passages free from discharge, and presume a complete absence of paralysis and cardiac weakness.

Diet.—In view of the depressant effect of diphtheria, it is desirable that the patient's strength should be maintained by the careful administration of a nourishing diet; careful, because it is important that nausea should not be induced by overfeeding or unsuitable food, owing to the great strain which vomiting throws upon the heart. Milk and good beef-tea are sufficient during the acute stage of the illness. If the patient is seriously ill, the milk should be diluted with water or barley water, and 30 gr. of citrate of potash should be dissolved in each pint. If milk is distasteful to him, some of it may be replaced by junket. As the patient's condition improves a gradual return is made to ordinary diet. Should there be any complaint of nausea, the milk may be peptonised for fifteen minutes before use, but if actual vomiting occurs, all nourishment must be administered per rectum, a similar apparatus to that used for nasal feeding being employed for the purpose.

REMEDIAL TREATMENT.

(*a*) **General Treatment.**—(1) *The Use of Antitoxin.*—This is by far the most important remedy that we possess for the treatment of diphtheria, though there are still some who deny its power to influence the course of the disease. Sceptics maintain that the great fall in the mortality from diphtheria which has taken place since the introduction of antitoxin is partly due to the fact that the type of the disease has become less severe than it was fifteen years ago, and partly to the fact that the employment of bacteriology for the purpose of diagnosis has shown that the Klebs-Loffler bacillus may be associated with mild forms of sore throat which in pre-bacteriological days would have been regarded as cases of simple tonsillitis. There is some truth in both of these contentions, especially in the second one, though even in faucial cases the much better results obtained by the early, as compared with the late, use of antitoxin should be sufficient evidence of the specific influence possessed by this remedy. Fortunately, we have in laryngeal diphtheria a form of the disease which cannot be said to have altered in character during the last two decades, and which offers the most positive evidence of the beneficial effect of antitoxin, not only by the much higher percentage of recoveries after tracheotomy or intubation, but also by the fact that the proportion of laryngeal cases requiring operation is smaller than it used to be. Those who dispute the value of antitoxin are apt to forget that in some of the worst cases of diphtheria a mixed infection is the cause of death, the diphtheria bacillus being associated with various pyogenetic organisms, of which streptococci are probably the most important. In the laboratory antitoxin can be shown to be an absolute antidote to diphtheria toxin, and this experimental evidence is confirmed by clinical experience. By means of it we are able to neutralise the free toxin circulating in the system. But when once the toxin has become fixed by the tissue cells, antitoxin is powerless to affect it; hence the immense importance of using this remedy as soon as the nature of the illness is suspected. The practitioner should never wait to have his diagnosis confirmed by the bacteriologist, if the case is one that is likely to need antitoxin. Inject first and diagnose afterwards should be his rule, if he feels unable to decide the nature of the illness on clinical evidence alone. It is far better to give an unnecessary dose of antitoxin than to postpone injecting it for twenty-four hours in a case that may ultimately develop into a severe does not support this view. Meadows Turner, in his report on "return cases" in connection with the hospitals of the Metropolitan Asylums Board, gives figures showing that 7,673 recovered diphtheria patients, discharged from hospitals at which the bacteriological test was employed before patients were allowed to go home, had an infectivity rate of 1·13 per cent., while 5,842 patients discharged from hospitals where this special examination was not made had an infectivity rate of only 1·02 per cent. These figures certainly do not favour the view that it is wrong to allow a diphtheria convalescent to mix with the general public before he has been shown on the authority of bacteriological examinations to be free from the Klebs-Loffler bacillus. Should the practitioner decide to rely on this test, the patient should be detained until at least two, and preferably three, consecutive cultures have given negative results. If the bacilli persist for any length of time after the patient is otherwise fit for discharge their virulence should be tested. If proved to be non-virulent, the patient may be discharged. Such persistence is likely to occur in children with adenoids and large tonsils, conditions which hinder the elimination of infection. The nasal passages are especially prone to harbour bacilli for protracted periods, but these are frequently found to be devoid of virulence.

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REMEDIAL TREATMENT.

(*a*) **General Treatment.**—(1) *The Use of Antitoxin.*—This is by far the most important remedy that we possess for the treatment of diphtheria, though there are still some who deny its power to influence the course of the disease. Sceptics maintain that the great fall in the mortality from diphtheria which has taken place since the introduction of antitoxin is partly due to the fact that the type of the disease has become less severe than it was fifteen years ago, and partly to the fact that the employment of bacteriology for the purpose of diagnosis has shown that the Klebs-Loffler bacillus may be associated with mild forms of sore throat which in pre-bacteriological days would have been regarded as cases of simple tonsillitis. There is some truth in both of these contentions, especially in the second one, though even in faucial cases the much better results obtained by the early, as compared with the late, use of antitoxin should be sufficient evidence of the specific influence possessed by this remedy. Fortunately, we have in laryngeal diphtheria a form of the disease which cannot be said to have altered in character during the last two decades, and which offers the most positive evidence of the beneficial effect of antitoxin, not only by the much higher percentage of recoveries after tracheotomy or intubation, but also by the fact that the proportion of laryngeal cases requiring operation is smaller than it used to be. Those who dispute the value of antitoxin are apt to forget that in some of the worst cases of diphtheria a mixed infection is the cause of death, the diphtheria bacillus being associated with various pyogenetic organisms, of which streptococci are probably the most important. In the laboratory antitoxin can be shown to be an absolute antidote to diphtheria toxin, and this experimental evidence is confirmed by clinical experience. By means of it we are able to neutralise the free toxin circulating in the system. But when once the toxin has become fixed by the tissue cells, antitoxin is powerless to affect it; hence the immense importance of using this remedy as soon as the nature of the illness is suspected. The practitioner should never wait to have his diagnosis confirmed by the bacteriologist, if the case is one that is likely to need antitoxin. Inject first and diagnose afterwards should be his rule, if he feels unable to decide the nature of the illness on clinical evidence alone. It is far better to give an unnecessary dose of antitoxin than to postpone injecting it for twenty-four hours in a case that may ultimately develop into a severe attack of diphtheria; for statistics show that every day that elapses between the onset of the illness and the use of antitoxin diminishes the patient's chance of recovery. Further, it must be remembered that antitoxin is absorbed very slowly after subcutaneous injection. Many hours elapse before the whole of it enters the circulation, and during that time a portion of the toxin, at least, has had the opportunity of injuriously affecting the heart muscle and nervous system.

The Dose.—There are three points to be taken into consideration in deciding how much antitoxin shall be injected—the character of the attack, the day of disease, and the age of the patient. Of these the first is by far the most important, while the age of the patient, except in the case of babies less than a year old, has little bearing on the size of the dose. A patient who is not seen until the fourth day of illness will require a larger amount than one who is seen on the second day, since with attacks of equal severity the former will necessarily have more diphtheria toxin circulating in his system. At the present time there is a tendency to give rather smaller doses than was the practice a few years ago. From giving too little physicians went to the other extreme, as they were assured that an excess of antitoxin would do no harm to the patient; hence, to be certain of injecting enough, they threw a surplus into the circulation. It is now recognised that not only is this a wasteful use of an expensive remedy, but the serum reaction, with its attendant discomforts, which occurs in a considerable number of cases, is apt to be unduly and unnecessarily severe.

A child with extensive exudation and nasal discharge, or one with laryngeal symptoms, should be given 8,000 units; if less than twelve months old, 6,000 will be sufficient. If the patient be injected during the first or second day of illness this dose should be repeated at the end of twenty-four hours, but if not seen until the third or fourth day, or if symptoms of toxæmia are already obvious, it is as well to repeat the injection at the end of twelve hours. In either case it will be advisable to give a third, and possibly a fourth injection of 4,000 units, unless there is a decided improvement in the patient's condition. Should the exudation have spread but a short distance on to the palate, the nasal fossæ not being involved, 4,000 units should be given. This dose should be repeated at the end of twenty-four hours if the exudation is still spreading, but if there is nasal discharge a full dose of 8,000 units ought to be injected. Should the membrane be strictly limited to the tonsils, and the symptoms otherwise mild, 2,000 units would be sufficient. This may be regarded as the minimum dose. Adults, if anything, require less antitoxin than children, as in them the disease rarely assumes the malignant form, and a fatal issue occurs in less than 2 per cent. Young children, and every patient who has nasal discharge in addition to a deposit on the fauces, should be injected without exception; but older patients who have nothing more than a patchy or pultaceous deposit limited to the tonsils seldom require antitoxin.

There is one condition in which it is necessary to be cautious in the use of this remedy, and that is in the case of a patient suffering from a relapse, who was injected during the primary attack. Such patients are sometimes extremely sensitive to the action of antitoxin (anaphylaxis), and in them its sequelæ are apt to occur both early and in a very aggravated form ; consequently, antitoxin should not be given under these circumstances unless the need for it is clearly indicated.

Method of Administration.—Antitoxin may be administered either subcutaneously or intravenously. It has also been given by mouth and by rectum. The last two methods hardly call for serious consideration. Except in rare cases, it is injected subcutaneously, the most convenient site for the operation being the anterior or lateral aspect of the abdomen. Should local inflammation be set up by the serum, less discomfort is caused, and the condition is more conveniently treated than when it occurs in the back or between the shoulder blades. Before the antitoxin is administered the skin at the site of injection must be thoroughly cleansed with soap and water and the needle and syringe rendered surgically clean. A good form of syringe is one made of metal and glass, as it is readily sterilised. Syringes made entirely of glass are better still, but are easily broken. It is usual to have a short length of flexible tubing between the syringe and the needle, to prevent any risk of the latter being broken by a sudden movement of the patient. If the practitioner decides to inject the serum beneath the skin of the right side of the abdomen, he should stand at the patient's left hand, with the needle of the syringe pointing away from himself. This is especially necessary if there is no piece of flexible tubing between the syringe and the needle, since the latter might be broken, or driven through the abdominal wall, should the child turn suddenly towards the operator. The serum having been injected, the puncture made by the needle may be covered with a shred of absorbent wool or gauze, and painted with collodion.

Intravenous Injection is reserved for very severe cases, especially such as do not come under treatment until a late stage of the illness. Since these patients have a large quantity of toxin circulating in the system, the intravenous injection of antitoxin should be highly beneficial, for in this way the full dose of the antidote is at once brought into contact with the poison. That the results of this method have failed to come up to the expectations aroused by Cairn's original paper on the subject is possibly due in part to the fact that the patient's tissues are engaged in combating the products of septic organisms as well as those of the diphtheria bacillus. The presence or absence of pyogenetic organisms or their toxins in the system may be the deciding factor as between death and recovery. When antitoxin is injected intravenously, a large dose, such as 20,000 or 30,000 units, is usually given; and, if procurable, a special serum containing no antiseptic should be used. To make sure of introducing it into the median cephalic, or median basilic, vein of a young child, that vein must be exposed by dissection. If a few drops of eucaine, or eucaine and adrenalin, are injected beneath the skin over the vessel, the child will take but little notice of the operation. The vein having been exposed, the antitoxin, which has been standing in hot water, should be poured into the barrel of a 2-oz. glass syringe. This ought to be connected by a short length of fine drainage tubing with the needle, which is then passed through the wall of the vein, the whole of the apparatus having previously been carefully sterilised and warmed. This method is preferable to emptying the syringe into the vein and then detaching it from the needle for the purpose of refilling it. To prevent the introduction of air, a few drops of antitoxin should be allowed to escape from the needle before the point is pushed through the wall of the vein. In a grown-up person the needle of an antitoxin syringe can usually be passed through the skin into the vein without any great difficulty, but these urgent cases rarely occur in adults.

The Prophylactic Use of Antitoxin.—Antitoxin may also be given as a prophylactic to those who have been exposed to the infection of diphtheria. When an outbreak of diphtheria occurs in a school or hospital ward, everybody in the school or ward should have cultures made from their throats. Those found to be harbouring diphtheria bacilli should be isolated and given 1,000 units of antitoxin ; for the others, 500 units will be sufficient. The protection conferred lasts for three or four weeks. The following instances are illustrative of this protective power. Five cases of diphtheria occurred in the course of a week on the girls' side of a Poor Law school. The children on that side were given 1,000 units of antitoxin apiece, and the outbreak immediately ceased. At a large boys' school eight cases of diphtheria occurred in the course of five days. Cultures were taken from every one of the scholars, and the Lister Institute reported that 109 boys out of about 540 had diphtheria bacilli in their throats. While this examination was being made three other boys developed diphtheria. The 109 bacillus-carriers were isolated from the rest of the school and each of them was given 1,000 units of antitoxin, the other boys receiving 500. Only one other case of diphtheria occurred, and that not until five weeks after the use of antitoxin.

The sequelæ of antitoxin are unpleasant rather than dangerous, and, with the exception of suppuration at the site of injection, are due to the irritating effect of horse serum. Rashes of various kinds follow the use of this remedy in about 40 per cent. of the patients injected, and joint pains in about 5 per cent. As a rule no special treatment is required for either, but occasionally an urticaria causes so much irritation that it is necessary to sponge the patient with a weak carbolic lotion containing bicarbonate of soda; or the joint condition may prove sufficiently destructive of rest to call for the administration of an opiate. Aspirin, too, is useful for the same purpose.

(2) *Treatment by Drugs.*—In the early stages of uncomplicated diphtheria drugs are not required. During convalescence, however, a tonic containing strychnine and iron may be given with advantage.

(3) *The Use of Stimulants.*—Some physicians order alcohol from the first as a matter of routine, unless the case is a very mild one. They do so on the ground that diphtheria is a peculiarly depressing disease. Against this practice it may be urged that there is always more or less acute degeneration of the cardiac muscle in severe diphtheria; and that prolonged stimulation of such a heart may end in its complete exhaustion and the death of the patient. It is for this reason that some physicians think it better to avoid the use of alcohol and strychnine during the first three weeks of diphtheria, except in the case of sudden syncope. These remedies are useful in the later stages of the illness, when the heart may show signs of increasing weakness under the strain of some complication, and digitalis may then sometimes be given with advantage if the pulse be unduly quick or its rhythm irregular.

(*b*) **Local Treatment.**—This should be conducted on the same lines as those described in the article on Scarlet Fever, but the patient, unless the attack is a very mild one, should not sit up in bed to have his throat syringed on account of the risk of heart failure. In order to avoid this risk, the patient should be laid on his side, and his head brought to the edge of the pillow, with a basin so placed as to catch the lotion as it runs out of the mouth in the act of syringing. Should the child object to its throat being syringed, and struggle much during the operation, it is wiser to discontinue this part of the treatment rather than to persist and run the risk of putting a dangerous degree of strain upon a heart which is already weakened. Formamint tablets may be used with advantage under these circumstances. Children like them, and, as a rule, can be induced to suck one frequently. Patients with rhinorrhœa should have their nasal passages douched with warm boracic lotion. No attempt ought to be made to strip forcibly membrane from the fauces, except when it is partially detached and is proving a source of annoyance to the patient. The application of strong antiseptics or caustics to the fauces, with a view to checking the further spread of exudation, is likely to do harm rather than good by lowering the vitality of the parts so treated; but to swab out the throat gently with a pledget of wool soaked in Izal is hardly open to this objection; indeed, its anæsthetic property may prove of some assistance. Hot fomentations or poultices should be applied to the neck when there is tenderness or decided glandular enlargement, and also in cases with much faucial swelling and pain in swallowing. Great care should be exercised in dealing with discharges from the nose and mouth. Pieces of soft rag or absorbent wool which have been wrung out of some weak antiseptic lotion should be used to wipe them away, at once be placed in a porringer and subsequently destroyed by burning.

LARYNGEAL DIPHTHERIA.

A patient who presents symptoms of laryngeal diphtheria, however slight, should be given a full dose of antitoxin, and be placed in a steam tent as soon as possible. A tent that covers the upper third of the bed is to be preferred to one that completely surrounds the patient, since it allows the air to circulate more freely. A clothes-horse and a couple of sheets are all that is required. If the symptoms of laryngeal obstruction are well marked, and it is desired to test the effect of the steam treatment in as short a time as possible, a croup kettle should be placed on each side of the bed, the patient's hands being wrapped in lint to protect them from any chance of getting scalded. The use of an emetic in these cases is not to be recommended. If, in spite of this treatment, the laryngeal symptoms become more marked, the question of performing tracheotomy or intubation will have to be decided. The need for operative interference will depend on the depth of cyanosis, the degree of restlessness, the amount of recession, and the nearness of medical assistance. In a hospital, where it is naturally possible to wait longer than it would be safe to do in private practice, increasing restlessness, marked recession of the chest walls on inspiration, and the fact that inspiration is so impeded as to demand a definite muscular effort for its accomplishment, must be taken to indicate that the time has arrived for operation. If such symptoms are left unrelieved, the child soon becomes exhausted; its heart dilates under the strain, the bases of the lungs collapse, and drowsiness gives place to coma. In private practice it would not be safe to leave a child with decided laryngeal obstruction, as there is always the risk of asphyxia from spasm of the glottis. Unless the practitioner is prepared to stay in the house with the patient, he would be well advised to operate if the symptoms of laryngeal obstruction are well marked, or the patient has already had one attack of laryngeal spasm. In the event of his having had little or no experience of these cases the practitioner must be on his guard against mistaking for sleep the stupor produced by carbonic acid poisoning. This is apt to follow the stage of restlessness, and quickly ends in death if not relieved by operation.

In deciding between tracheotomy and intubation, the surgeon who is equally proficient with either will probably elect to perform intubation in hospital, and tracheotomy if the case occurs in his private practice. The former is slowly gaining adherents. To intubate successfully, however, requires a good deal of practice, and if the patient's dyspnœa is urgent, the inexperienced practitioner will be wise in selecting tracheotomy. The advantage, however, of being able to relieve the patient at once without subjecting him to a cutting operation is undoubted, and there is little doubt that in hospital practice intubation will finally replace tracheotomy in this country as it has already done in France and America. In private practice, however, tracheotomy is the safer operation, for it is impossible to overlook the risk attached to the premature expulsion of an intubation tube when there is no medical man at hand to replace it.

Tracheotomy.—Some operators habitually perform tracheotomy without an anæsthetic, and after making the skin incision, plunge the knife at once into the trachea without any attempt at dissection. This rapid method may be the only one possible when the child is in imminent danger of asphyxia, but in view of the greater risk of hæmorrhage, and the likelihood of the opening being made at the side, instead of in the mid-line of the trachea, its performance can only be justified as a surgical emergency. If, however, it is decided to operate in this way, two assistants at least will be needed, one to stand behind the child and keep its head absolutely still, with the chin and sternum in the same straight line; the other to secure the child's hands and lower extremities. In the absence of a proper head rest, a rolled-up bath towel, or sheet, placed behind the patient's neck, will answer the purpose. No time is wasted in feeling for the cricoid, which is sometimes impossible of detection, but, fixing the upper part of the trachea with the thumb and second finger of the left hand, the surgeon makes an incision, 1 inch to 1½ inches long, ending just above the sternal notch. It is most important that this incision should be strictly in the middle line. The beginner will do well to mark it out with a blue pencil before commencing the operation. Still keeping the thumb and second finger in the same position, the operator locates the trachea with his index finger, and, using his nail as a guide for the point of the knife, stabs the trachea and cuts it for about ⅜ inch in an upward direction. Without removing the index finger, the operator next inserts the dilators and very gently dilates the opening in the windpipe, whereupon there will be a great spluttering of blood and mucus, followed by several deep inspirations. No attempt should be made to stop any venous hæmorrhage that may occur as a result of the first incision, unless it is excessive. As the tracheal dilators are introduced, the child's head should be allowed to hang well down over the end of the table, to prevent blood entering the air passages. With the first deep inspiration such hæmorrhage, as a rule, immediately ceases. Any membrane seen in the trachea should be removed with forceps, after which the tracheotomy tube is inserted and fastened with tapes at the side of the neck. Parker's tubes are used more often than any others, but their introduction is facilitated if the pilots are fitted with full length handles. Personally, we prefer Durham's tracheotomy tubes with the lobster-jointed cannula. Their adaptability to the varying depth of the trachea, in different cases, owing to the shield being movable on the tube, renders their use more comfortable to the patient. They are, however, more expensive, and the lobster-joints are apt to get out of order if not carefully treated. A single thickness of lint, wrung out of glycerine of borax, and covered with jaconet, each being half divided by a cut on account of the tube, should be placed over the wound beneath the shield to serve as a dressing. Should the child stop breathing during the operation the practitioner need not be unduly alarmed, as it will almost certainly come round if artificial respiration is carried out immediately the trachea is opened.

If there is time to operate with deliberation it is much better to expose the trachea before opening it, in which case an anæsthetic is certainly to be recommended. A few whiffs of chloroform will dull the pain of the skin incision, or a subcutaneous injection of eucaine and adrenalin may be used instead. When this form of operation is carried out in hospital it is rendered easier if the child's head is fixed on a tracheotomy rest, a convenience which is usually available. The scalpel should be very sharp and the light as good as possible. It is important that the different layers between the skin and the trachea should be divided the full length of the wound and that care be taken to avoid pricking the windpipe before the layer of fascia overlying it is divided. Should this happen, the connective tissue between the two becomes blown up with air and makes the exposure of the trachea a much more difficult matter.

Nothing has so far been said as to the respective merits of *high and low tracheotomy*. In young children the space in which the operator has to work is so limited that very often the operation is neither one nor the other, the isthmus of the thyroid being divided; indeed, when a rapid tracheotomy has to be performed in an urgent case this is what usually happens, and, as an alternative to making the opening so high up as to divide the cricoid even partially, it is much to be recommended. The object of the surgeon should always be to open the windpipe as *low down* as practicable, even should the thyroid isthmus have to be divided. The low operation is apt to be more difficult of performance for several reasons: there is increased risk of hæmorrhage from the inferior thyroid plexus of veins, the trachea lies deeper, and the thymus gland, as a rule, appears in the wound, and gets in the way of the operator. The ultimate results, however, are better. The tube sits more comfortably in the neck, and no difficulty is ever experienced in doing away with the tube when the time arrives for its final removal.

In view of these facts the low operation should always be performed when an anæsthetic can be given, and the trachea exposed by dissection; especially is this true in hospital practice, where the surgeon has the advantage of skilled assistance. Under these circumstances it is usually possible to draw the isthmus of the thyroid upwards and open the trachea below it. If this is not practicable, the isthmus should be divided, if necessary, between two pairs of artery forceps.

The difficulty occasionally encountered in permanently leaving out the tube is caused by the growth of exuberant granulations from the interior of the larynx and trachea in the neighbourhood of the tracheal opening, the result of prolonged irritation of the mucous lining. Cicatricial contraction of this new-formed tissue sets in the moment the tube is removed, and soon necessitates its replacement. By operating well away from the larynx this irritation and consequent formation of granulation tissue is avoided.

It is better to discontinue the use of steam after tracheotomy, unless a dry form of tracheitis or bronchitis is present, and merely place a few layers of moist gauze over the tube to act as a filter. The great secret of success is to leave the child alone after the operation. Feathers should never be used, except by the direct orders of the practitioner. Should the patient be troubled with a frequent ineffectual cough, indicating that the mucus is too dry to be dislodged from the walls of the air passages, spraying the trachea lightly through the tube, or through the open wound, with a warm solution of sodium bicarbonate, 15 gr. to the ounce, will sometimes give relief. The inner tube should be removed and cleaned whenever the breathing becomes noisy or obstructed, and the outer tube changed once in the twenty-four hours. In a majority of cases it is possible to remove both tubes permanently within two or three days of the operation. Sometimes this final removal is delayed by the patient's nervousness. In such cases it is a good plan to substitute a rubber tracheotomy tube, with an opening in its upper convex border, so that air can be drawn into it through the larynx. When the child is asleep the outer end of the tube can be completely closed by the introduction of a little plug of cotton-wool; or it can be gradually shortened until so much of it has been cut away that the inner end of it lies outside the trachea. Should a child on whom tracheotomy has been performed show any inclination to interfere with the tubes, paper or thin cardboard splints should be bound round its elbows. The feeding of these patients presents no difficulty as a rule, but occasionally there is a tendency for fluids to enter the larynx, when the tube is finally removed, and sometimes earlier. If the milk is thickened with cornflour, or arrowroot, or Benger's food, the child will usually be able to swallow it; if not, recourse must be had to nasal feeding.

Intubation.—It will not be necessary to describe this operation in any detail, as it is not one that the general practitioner is likely to perform in private. The best form of tube is the shortened modification of O'Dwyer's, which has been introduced by Bayeux. It can be obtained in either metal or vulcanite. Before commencing to intubate a patient everything should be got ready for tracheotomy, as there is always a possibility that the intubation tube, as it is introduced, may push membrane in front of it and cause complete obstruction. The patient should be kept in steam after intubation has been performed, to lessen the tendency to clogging of the tube with mucus, and be fed by means of a nasal tube, if there is any difficulty in swallowing. By slightly thickening the milk, however, and keeping the patient flat, it is usually quite possible to feed him without any of the food passing into the windpipe. If the tube is retained for a period of three days, re-intubation will probably not be called for.

HÆMORRHAGIC DIPHTHERIA.

If definite purpuric spots are present in the skin the disease is always fatal, even though there be nothing more than a few petechiæ to indicate that the patient is suffering from this form of disease. When the nasal fossæ are involved, there is usually a more or less constant trickling of blood from the anterior nares after the membrane has separated. This symptom is also seen in severe cases of diphtheria which are not definitely hæmorrhagic. Douching the nasal passages with iced water, spraying them with adrenalin, or inserting a plug soaked with a 1 in 1,000 solution of the same preparation, and the external application of iced wet wool should all be tried if necessary. The last-named will sometimes stop the bleeding and is less disturbing to the patient than either of the others. These patients must be handled very gently, as has been already pointed out, because they bruise so readily.

TREATMENT OF COMPLICATIONS.

The complications of diphtheria consist for the most part of the effects of acute degenerative changes in the parenchyma of the heart muscle and certain portions of the nervous system, directly induced by the action of the diphtheria poison.

Cardiac Weakness.—Varying degrees of heart weakness occur in all but the milder forms of diphtheria. In the first two weeks of the illness, at any rate, they are caused by degenerative changes in the cardiac muscle, and, possibly, the vagus nucleus, and their urgency depends on the extent of this change. Undue slowness, or marked rapidity of the pulse, irregularity of the cardiac rhythm, lengthening of the pause between the first and second sounds, and shortening of the interval between the sounds, are all indicative of grave heart weakness, and call for the most watchful care on the part of the physician. Absolute rest in the recumbent position must be insisted on, and no pillow, unless a very thin one, should be allowed. Any form of treatment likely to disturb the patient, such as throat syringing, should be omitted. The diet should be made as light as possible, and the quantity of fluid in it diminished; while nothing should be given which might ferment in the stomach, and, by distending that organ, cause embarrassment of the heart's action. Cardiac failure may be the final development of a depression of the heart's action characterised by some of the indications already mentioned, or it may set in suddenly with vomiting, and an alarming alteration in the character of the pulse. In some cases there is also severe præcordial pain. A patient exhibiting these symptoms has very little chance of recovery. All nourishment must be administered per rectum. Nothing but occasional sips of hot water for the relief of thirst should be given by the mouth. Even this may set up vomiting. The foot of the bed should be raised to assist the patient in retaining the nutrient enemata. It is worse than useless to attempt to influence this form of vomiting by drugs, since it persists when nothing whatever is given by the mouth. Hot fomentations applied to the chest wall will assist in relieving the heart pain, but if this is severe, it may be necessary to give a small dose of morphia and atropine hypodermically. Adrenalin has been praised by some physicians for its action in this condition, and belladonna, which paralyses the terminal fibres of the vagus, is of value when the pulse is unduly slow and the vomiting persistent. Allusion has already been made to the objection to any attempt being made to stimulate an acutely degenerated heart with alcohol and strychnine. In opposition to this view, however sound it may appear to be theoretically, it is a practical fact that during recent years one of us has found that the combination of $\frac{1}{100}$ gr. of strychnine with $\frac{1}{100}$ gr. (increased to $\frac{1}{50}$ gr.) of atropine, and 5 mins. of a 1 in 1,000 solution of adrenalin chloride injected every four or six hours hypodermically, has been the means of saving a number of young children whose condition from cardiac failure appeared to be quite hopeless.

Paralysis.—When this complication appears in a patient who is up and about he should at once return to bed, even though it is only the soft palate or the ciliary muscle which is affected. At the same time it as well to put him on a course of strychnine. Provided no other muscles become affected, and the condition shows improvement, he may get up again a few days later. In cases where the muscles of the trunk or limbs become involved, in addition to complete rest in bed, the daily application of the galvanic current for a few minutes will be of some assistance when recovery is unduly protracted. It is, however, rarely needed. Electricity should never be employed until the paralysis has ceased to extend, whether motor or sensory. If used before the nerve changes causing the paralysis have become quiescent the effect may be to aggravate the condition.

During the middle or latter part of the second month certain of the muscles of deglutition and respiration not infrequently show loss of power in patients who have had severe attacks of diphtheria. Careful watch should always be kept for any evidence of weakness in the muscles of the larynx and the pharyngeal constrictors, as the inability to swallow, combined with imperfect closure of the glottis during the act may result in food finding its way into the air passages and setting up broncho-pneumonia. Coughing, induced by the act of drinking, is the first symptom of this condition, and is usually quite distinctive. If there is only slight weakness of the constrictors the difficulty may be overcome by thickening the milk with arrowroot or cornflour, otherwise the patient must submit to nasal feeding.

A very trying form of paralysis which is also liable to appear about this time is that in which there is loss of power in the diaphragm combined with laryngeal anæsthesia and loss of power in the muscles which close the glottis. As a result the voice is lost, and cough is quite ineffectual, as the patient is unable to clear his trachea and bronchial tubes of mucus. Owing to the discomfort and interference with respiration he gets but little sleep, and in severe cases it appears as if the child might be asphyxiated. This condition can, however, be relieved by the hypodermic injection of atropine, which will diminish the secretion of mucus. If the foot of the bed is raised at least 12 inches from the floor, the fluid in the trachea will gravitate into the pharynx, from whence it can be removed by swabbing with pledgets of cotton-wool held in a pair of dressing forceps. No pillow should be allowed, but one should be placed between the child's head and the upper end of the bed, as raising the foot will make the patient tend to slip towards the head of the bed. If there is a marked accumulation of mucus in the lungs, forcible compression of the sides of the thorax, as in artificial respiration, will assist in clearing the air passages by driving some of the fluid into the pharynx.

Affections of the Kidneys.—The *albuminuria* of diphtheria is of much less importance than the same symptom in scarlet fever. If unaccompanied by any other sign of renal disturbance. it always clears up, and consequently requires no special treatment. *Anuria*, on the other hand, is a most serious condition, and, if complete, is almost invariably followed by death in the course of a day or two. There is no treatment for it which holds out much prospect of success, since it is always associated with profound toxæmia or acute heart failure. *Nephritis* is rarely seen in diphtheria. When present, it requires the same treatment as in scarlet fever, except that hot baths and packs should be used with greater care on account of the possibly degenerated condition of the heart muscle.

Otitis Media.—For the treatment of this complication the reader is referred to the article on Scarlet Fever. Care should be observed in the disposal of the discharge, and the possibility of it containing the Klebs-Loeffler bacillus should not be forgotten.

F. FOORD CAIGER and H. E. CUFF.

ENDOCARDITIS, INFECTIVE.

(MALIGNANT ENDOCARDITIS; ULCERATIVE ENDOCARDITIS.)

Prophylaxis.—It has been conclusively shown that by far the commonest micro-organisms causing infection of the endocardium (in over 70 per cent. of cases) are the short-chained streptococci of the type found in the alimentary canal (*S. Salivarius* and *S. fæcalis*). It follows that in persons who are the subjects of chronic valvular disease, and who are therefore liable to malignant endocarditis, special attention should be paid to the state of the teeth and gums; pyorrhœa alveolaris and other forms of oral sepsis should be treated, and septic stumps should be removed. It is doubtful if any definite preventive means can be undertaken against the passage of intestinal cocci into the blood-stream, but it is possible that this passage is minimised by the strict avoidance of constipation. So far as the writer knows it has never yet been suggested that the subjects of valvular lesions should be inoculated by vaccines derived from their own salivary and intestinal cocci, but the suggestion is by no means unreasonable in face of all the facts. The advent of the gonococcus can, of course, be prevented at will; that of the pneumococcus and of the influenza bacillus much less so.

TREATMENT.

(1) **Non-specific Measures.**—*Open air* is certainly of great importance, as in other infective processes. The writer has seen good results from rigid open-air treatment, as employed for pulmonary tuberculosis, and insists upon this in all chronic cases. *The diet* should be liberal, and limited only by the state of the stomach and the presence of dilatation of the heart. *Alcohol* is of very doubtful value if a serious effort is being made at cure rather than palliation, unless in the form of good red wine, which is of service as a tonic and hæmatinic. The progressive anæmia demands a careful choice of suitable articles of food to combat this complication. The *fever* is best met by hydrotherapeutic measures and not by drugs. *Nursing* is very important, as it is essential that the patient should rest completely, and attempt

no effort of himself. He is, of course, in bed continuously. On no account must the sanguine temperament shown by many patients who suffer from this very serious malady be allowed to modify any of the rigours of the treatment as laid down by the physician. In every case the prognosis is as grave as it can possibly be in any disease except that of inoperable malignant growth : it can but be more grave still if time is wasted before the plan of campaign is properly started.

Medicinal Treatment.—A large number of drugs have been tried in the treatment of this disease, but it cannot be said that in the case of any one of them more than a suggestion of possible value has followed its use. The salicylates seem devoid of good effect, except in lowering the temperature, a procedure of doubtful benefit. Of quinine, even in large doses, the same comment may be made. The sulphocarbolates were at one time thought to be of service, but the writer's experience of them is very disappointing ; he has used them very freely, up to 20 gr., every two hours, but has never effected a cure by their means. Mercury, given to the point of salivation, has been followed by temporary amelioration in two cases of chronic streptococcal endocarditis treated by the writer, but recrudescences occurred in both instances. Some observers speak well of arsenic, others of the organic preparations of silver (collargol, protargol), but no records of undoubted cures are to hand.

Preparations, the immediate effect of which is to induce a *leucocytosis*, are certainly of theoretical value, especially in those cases, not seldom occurring, in which there is a low leucocyte count. The simplest of these is nuclein, which may be given by mouth or subcutaneously, and which may be combined with whatever specific measures are being employed at the same time. If given subcutaneously, ♏ 10 to 15 of a 10 per cent. solution may be used daily. Sodium orthocoumerate may be used in the same doses to produce a similar effect. If given subcutaneously it is well to dilute the dose to about twice its bulk to avoid local damage to the tissues. To get a more rapid effect, either of these substances may be given intra-venously. It is possible that the good effects occasionally seen from the use of normal horse serum are due to the temporary excitation of a leucocytosis.

(2) Specific Measures.—Seeing that malignant endocarditis is not an entity, but a form of infection of the endocardium due to one or other of a number of micro-organisms, it would indeed be surprising if any drug treatment proved to be successful in all cases, even if it proved to be successful in cases due to the same

type of infection. As a matter of fact, experience shows that, beyond certain indirect effects witnessed from their use, drugs do not control the course of the disease in any form of infection. The best hope of cure would seem to lie in the selection of some remedy which has a specific effect upon the growth of the infecting microbe and upon the neutralisation of its toxins in the body. Until some effective form of treatment is devised along these two lines it cannot be said that the problem has been touched in the therapeutic sense. Were the seat of infection a less vital structure, careful attention to non-specific measures might allow of successful combating of the disease by the natural resources of the patient thus enhanced. But with the focus of the infection situated at the very centre of the circulation, and with the tendency to dissemination of the infecting agent, it is imperative to check the disease-process at as early a stage as possible.

The specific measures that may be employed are of two kinds :

(*a*) *Bactericidal Sera.*—The specific serum for which most success can at present be claimed in therapeutics is undoubtedly anti-streptococcus serum, and as most cases of ulcerative endocarditis are of streptococcal origin, it is reasonable that a full trial should be given to this remedy in any case ascertained by blood culture to be of this nature. It cannot, however, be said that any definite success has followed this plan of treatment hitherto. The disappointing results may be attributable to the fact that in the great majority of cases the type of streptococcus at work is not that type against which most, if not all, of the antisera on the market have been prepared. This objection applies almost as much to the so-called " polyvalent " sera as to the earlier products. The preparation of a special serum against the particular streptococcus obtained from the patient's blood requires some four to six weeks in order to render it reasonably potent. This was done by the writer in one case, but without a satisfactory result. The case was, however, too acute to admit of the serum being ready for use before the patient was very ill. The method deserves further trial, especially in chronic cases, in which the duration of the disease may be several months, or even a year or two. A better plan might be the systematic preparation of a special serum against a dozen strains of streptococci obtained from cases of ulcerative endocarditis, so that this " anti-streptococcus serum (endocarditis) " might be used instead of the ordinary serum, to which recourse is usually had. In a few cases of the disease, generally running an acute course—sometimes a fulminating course—the streptococcus concerned is *S. pyogenes.* If this is ascertained in any particular case, a special univalent "pyogenes" serum should be used. In other instances of acute infections by *S. pyogenes* the writer has found this serum of greater benefit than the favourite "polyvalent" serum, and other observers have confirmed this experience. In cases ascertained to be due to the *pneumococcus*, some potent brand of anti-pneumococcus serum, such as Pané's, should be used. It is only right to add that in the experience of some physicians the use of anti-sera seems to have been fraught with ill-effects in the form of exacerbations of the fungating process occurring at the focus of infection. The writer has not seen such ill-effects, but his practice is to confine the use of sera to fulminating or acute cases in which there is considerable evidence of general toxæmia.

(*b*) *Bacterial Vaccines.*—Following upon the success which attended the use of vaccines in staphylococcal infections, hopes were entertained that similar results might follow their employment in infective endocarditis, despite the knowledge that in this disease a state of general infection (septicæmia) has to be dealt with. It is perhaps too early at present to form conclusions as to results, but these have certainly not been very encouraging. Quite early in the history of vaccine therapy as applied to pyogenetic diseases, Barr, Blair Bell and Douglas reported an acute case treated successfully at Liverpool; but there is considerable doubt as to the existence of actual endocarditis in this case. The writer has reported a case, due to *B. influenzæ,* in which vaccine treatment was followed by cessation of fever, gain in weight and colour, and a sterile blood-stream, but in which a fatal relapse occurred some weeks later. Latham has recently reported an apparently successful case (streptococcal) treated over a long period by vaccines administered by the mouth. Considering how common the disease is, and that vaccine therapy has now been extensively employed in pyogenetic infections of all kinds for some four or five years, it must be confessed that the results obtained in this particular disease are disappointing. But the method demands a much fuller trial, especially in the way of modification of dosage, both as regards frequency and size of dose, and certainly in the way of employing sensitised vaccines.

(*c*) *The Use of Sero-vaccines.*—It is possible to combine the two specific measures just described. This may be done by the separate use of anti-streptococcus serum and of small doses of autogenous vaccine, a not uncommon practice with the writer. A better method would probably be to use a sensitised vaccine prepared in a manner similar to that in which tuberculosis sero-vaccine is prepared. The cocci obtained by blood culture, after being washed and dried, would be mixed with anti-streptococcus serum and kept for several days in the incubator at 37° C. The cocci would then be separated off by centrifugalisation, washed with salt solution, made into an emulsion with 40 per cent. glycerine water and standardised. The use of such a sero-vaccine seems well worthy of trial.

SYNOPSIS OF THE TREATMENT OF A CASE OF INFECTIVE ENDOCARDITIS.

It is apparent that no very satisfactory scheme of treatment for this grave malady has as yet been evolved. But it is the duty of the physician to embark hopefully upon a thorough trial of certain cardinal principles in each case presented to him, for it is only so that the successful treatment of this disease, concerning the pathology of which we know so much, can possibly be established. As far as present knowledge goes these cardinal principles of the treatment of this condition are summed up as follows:

(1) **Non-specific Measures.**—Careful nursing, patient always recumbent. Fresh air in abundance. Liberal diet. Attention to skin, kidneys and bowels. Control of temperature by hydrotherapy. Treatment of anæmia by dietary, red wine and hæmatinic drugs. Treatment of dilatation of heart (if present) on principles laid down elsewhere.

(2) **Specific Measures.**—(*a*) *The case is acute.*—Normal horse serum to be administered in 25 cubic-centimètre doses daily, intra-venously or subcutaneously, pending the result of blood culture. Or similar doses of anti-streptococcus serum may be given on the probability of the infection being streptococcal in origin. If this alternative be decided upon, univalent pyogenes serum to be chosen in fulminating cases, and a special endocarditis serum to be chosen (if available) in acute cases. Nuclein to be administered in ♏ 10 to 15 of a 10 per cent. solution subcutaneously if leucocytosis be absent or trivial. On the result of the blood culture being known, the normal horse serum is changed for the appropriate anti-serum, in similar dosage, continuing for six days unless contra-indicated. The serum treatment is then suspended for a while, and the tentative use of autogenous vaccine, unsensitised or sensitised, is undertaken.

(*b*) *The case is sub-acute or chronic.*—Normal horse serum may still be administered, with the idea of supplying deficient complement. But it is unlikely that anti-sera are of much, if any, service. A sensitised vaccine should be prepared as soon as the blood culture is found to be positive, and very small doses of this sero-vaccine should be given subcutaneously or by the mouth. The initial dose may be one million of the sensitised cocci, or an equivalent of this in the form of the emulsion. The dose may be repeated on the fourth day and again on the eighth. The most complete and careful observations, clinical and hæmatological, must be made meanwhile. If no effect is noted, the dose should be carefully increased. Or the method may be varied by giving one, two and three million cocci on consecutive days, and allowing a week's interval before repeating the doses, which may then be doubled in amount. No rules can be laid down at present for the choice of effective size of dose or of effective frequency of administration. The estimation of the opsonic index does not seem to help in this difficulty; it is sometimes very high in this disease, even without the use of any specific measures. In one of the writer's cases, in which the index was carefully estimated, it rose steadily to over 3.0 before death, showing that it affords no reliable guide to the degree of the patient's immunity. Yet, judging from analogy with some staphylococcus infections, in which vaccine therapy may be successful despite the existence of a high opsonic index, such a state of things would not contraindicate the administration of a vaccine in the manner above described.

T. J. HORDER.

ERYSIPELAS.

Prophylaxis.—Erysipelas occurs with or without the presence of an obvious wound. When a wound, accidental or operative, has been inflicted the prophylactic measures against erysipelas resolve themselves into the ordinary aseptic and antiseptic methods of wound treatment. When no obvious lesion is present, the source of infection is some unnoticed abrasion of mucous membrane or skin, and here the likelihood of erysipelas to a large extent varies with the personal cleanliness and hygienic surroundings of the patient. When a case of erysipelas occurs the question must be considered how best to prevent spreading infection. It is true that while the skin remains unbroken, as it does when scratching is prevented, the causative organisms are not found on the surface of the skin; further, it is true that, given perfect aseptic and antiseptic precautions, an open wound affected by erysipelas is not a source of danger to other occupants of a surgical ward. It should, however, be well known how easily small errors of technique may occur and lead to disaster, and a surgeon who permits the treatment of a case of erysipelas in a ward containing clean, surgical cases is showing a rash confidence in the infallibility of himself and his assistants.

When the patient is under treatment in a private house isolation is not usually necessary. Those who have to attend to the patient should, however, be warned of the danger of infection through scratches and abrasions, and should exercise care in washing and disinfecting their hands. In all cases the affected areas should, when possible, be kept covered, gloves should be worn while dressing the wound, all dressings should be burnt when removed, and all instruments boiled. Bedding and linen should be disinfected by heat. The danger of infection may be considered to cease with the subsidence of the inflammation ; the scaling is not dangerous.

Local Treatment.—The host of remedies used in treating erysipelas owes its existence to the tendency of the disease to rapid recovery. In mild cases the following treatment is all that is necessary locally—it is simple, cleanly and comfortable to the patient: The affected area is washed carefully with ether soap and water, and bathed with biniodide lotion (1 in 2,000); it is then dried, dusted with zinc oxide and covered with a layer of sterilised wool, which is bandaged in position. If much burning and pain be complained of, cold compresses made with boracic lotion may be employed. Lead lotion, or Burow's solution, may be used in place of the boracic lotion for the compresses. The use of ice-bags is inadvisable, since cold lowers the vitality of the skin and increases the danger of sloughing. Ichthyol (25 to 50 per cent. solution in water) is a favourite remedy with some. It should be painted over the affected area and surrounding skin four or five times daily until the condition subsides, and then at less frequent intervals for another day or two to prevent the likelihood of relapse.

Many remedies have been tried to check the rapid spread of the inflammatory process. With the object of producing a barrier of leucocytes beyond the spreading edge, the skin at a distance of 1 inch from it has been painted with liquor iodi fortis or rubbed with the silver nitrate stick. Injections of pure carbolic acid into the healthy skin near the border of the rash probably act in the same way. Kraske recommends scarifying the skin with a scalpel, just deeply enough to draw blood, at a distance of not less than 1 inch from the spreading margin. An anæsthetic is needed as, to be effectual, the process must be thoroughly carried out. The scarifications should be numerous and cross one another, forming a meshwork. Afterwards dressings of lint damped in carbolic lotion (1 in 60) are applied. The application of firm pressure by means of strapping beyond the affected area, most applicable in the case of an extremity, is said to give benefit by compression of the lymph spaces, so arresting the spread of infection. When a wound exists vigorous measures should be taken to disinfect it. Free escape is provided for discharges, the surface of the wound treated with pure carbolic acid, and boracic fomentations applied and changed frequently.

In the treatment of ordinary cases of erysipelas incision is rarely required. When, however, parts are affected where there is much lax connective tissue, such as the eyelids or scrotum, multiple small incisions should be made to a depth of ½ to 1 inch with the point of a narrow-bladed scapel, and hot boracic fomentations applied. In cases of phlegmonous erysipelas, when the whole disease is of a much more serious nature, the subcutaneous tissues being affected, and extensive sloughing with severe toxæmia likely to ensue, there should be no delay in employing the knife. Multiple incisions, 2 to 3 inches in length, are made parallel to the course of the main vessels and nerves of the part. If pus is encountered, the cavities should be carefully swabbed out with sterilised gauze and tubes inserted, the whole area being covered with a boracic fomentation. If no pus is present, plugs of gauze are loosely inserted to keep open the incisions, and fomentations applied as before. In the case of phlegmonous erysipelas of the face it will be necessary to make an incision along the infra-orbital margin at least; the surgeon must keep in mind that the life of the patient is directly threatened by intra-cranial extension of the process along the numerous venous communications which exist, and the danger of blindness is not remote. He must not, therefore, be deterred by the fear of disfiguring his patient, but must incise wherever necessary.

Constitutional Treatment.—At the outset calomel (gr. 2) should be administered, followed by a saline purge. The patient is kept in bed and the limb, if that be the part affected, is raised. The diet should consist of milk, beef-tea and broth, eggs beaten up with milk, and, if necessary, brandy. A mixture containing iron, quinine and strychnine is advisable. By some iron is looked upon as a specific, and the liquor ferri perchloridi in ½-drachm [U.S.P. liquor ferri chloridi ♏ 8] doses is given every four hours. Since those addicted to alcoholic excess or who are the subjects of renal disease or diabetes appear to be prone to erysipelas, these conditions should be sought for and appropriately treated. The administration of anti-streptococcic serum has been advocated: an initial dose is given of 20 cubic centimètres, followed by 10 cubic centimètres twice a day. It is doubtful if it is of any service, and it is questionable also if its use can be defended on bacteriological grounds. A vaccine prepared from the streptococcus erysipelatis of Fehleisen cultivated from many different cases of the disease has been used during the past few years. Its results have been very promising, and it is likely to form the most reliable means at our disposal in the treatment of erysipelas. In severe cases an initial dose of 10 millions of the dead organisms is given. On the following day another dose of 10 millions is administered, if there is improvement in the clinical manifestations; if not, a smaller dose of 5 millions is given. After this on every second day 5 to 10 millions are given until the temperature has been normal for a week and the erythema has subsided. In less severe cases 20 millions may be given as an initial dose, and the treatment described above is then pursued, the doses being proportionately larger. This method, without the estimation of the opsonic index, has given excellent results; but when the blood examination is available, it is of great assistance in regulating the doses.

MAYNARD SMITH.

ERYTHEMA NODOSUM.

ERYTHEMA NODOSUM (NODAL FEVER) is a distinct and independent affection, almost certainly of bacterial origin and allied to the exanthemata. Its symptoms and clinical features are usually well defined. It runs a definite course, and three stages may usually be recognised: (1) The prodromal, from three to fourteen days; (2) the eruptive, which, with relapses, may be prolonged over several weeks; and (3) the stage of convalescence. One attack is protective and the disease is probably infectious to a slight degree, as a number of small epidemics are now on record. It is not a manifestation of rheumatism and only occurs in rheumatic subjects as a coincidence.[1] It is also entirely distinct from the other exudative erythemata.

The Prodromal Stage.—The chief symptoms are malaise and pains in the legs and about the joints, usually not severe. Patients seldom present themselves for treatment in this stage, and a diagnosis cannot be made with certainty before the appearance of the eruption, though if phlyctenules are present the probability of the case being one of erythema nodosum is very great. If the pain is so severe in this stage as to cause treatment to be sought the patient should be sent to bed and the limbs wrapped up or hot applications used. Such pains in children should in all cases excite the suspicion of possible rheumatism.

The Eruptive Stage.—This at once clears up the diagnosis and usually leads to medical aid being sought. The distinctive features are a general malaise, sometimes severe; pyrexia of varying degree and measuring largely the severity of the case; the eruption of nodes, which are tender to the touch; and pains in the limbs and about the joints, which are aggravated by the upright position and usually largely disappear with rest in bed. Actual effusion into the joints is noted in a few cases and phlyctenules may be present. The patient should be sent to bed and kept there so long as fresh lesions are appearing and for at least one week after the eruption has ceased. In mild cases the patient may now be allowed to leave the bed, but in severe cases, especially those in which the nodes have been large and painful, or in which the general constitutional symptoms have been marked, rest in bed is required for two or three weeks longer. In most cases the eruptive stage lasts a week or ten days and constitutional disturbance is but slight, but severe cases occur which are attended by considerable pyrexia and constitutional disturbance, and occasionally delirium. Ordinary rest in bed is all that is needed in many instances, the pain usually disappearing with the recumbent posture, but if necessary the painful areas may be soothed with warm fomentations or the application of glycerine and belladonna.

The usual practice is to give salicylate of soda, but this has no effect whatever in shortening the disease, and probably none in relieving the slight pain which usually exists. No special drug treatment is required in ordinary cases, and the temperature will be found to come down to normal just as well without as with salicylates. The diet should be light and digestible, and, if there is much pyrexia in the first few days, mainly fluid. The heart should be examined, as occasionally evidences of slight dilatation are found and there may be a soft localised systolic murmur at the apex. These signs need not, however, give rise to any anxiety, as rarely, if ever, does organic disease of the heart accompany or follow true erythema nodosum.

The Stage of Convalescence.—This is the stage of the disease in which treatment most often falls short of what is required. For a disorder which is in most cases slight, and which tends naturally to recovery, one is surprised at the amount of general debility and the length of time such debility persists. For this reason the stage of convalescence requires careful supervision. The resumption of normal activity should be gradual, and the anæmia and debility usually require active treatment. Iron and quinine are among the most suitable drugs and nux vomica may be added.

W. H. MAXWELL TELLING.

REFERENCE.

[1] Lendon, A. A., "Nodal Fever," 1905.

GANGRENE.

THE chief danger to a patient suffering from gangrene is the supervention of putrefactive processes in the dead part, and the consequent spread of sepsis to the living tissues, with all the septic complications that may ensue thereon. It follows, therefore, that the first point to which treatment must be directed is the prevention of this putrefaction. In all cases, whatever may be the cause, in which the advent of gangrene is feared, or in which gangrene is beginning, the part should be rendered as free as possible from bacteria. The affected part is shaved and washed thoroughly with ether soap and water, special attention being paid to the folds of skin about the nails, which are cut short. Biniodide of mercury in spirit (1 in 500) is next employed, and finally a voluminous dressing of dry cyanide gauze and sterilised wool is loosely bandaged in position. The limb is then raised on a pillow to favour the venous return, and hot-water bottles are placed near it. *General treatment* is, at the same time, adopted. The diet should be easily assimilable and generous. Stimulants are usually called for. Strychnine and digitalis may be administered when necessary, and opium should be given for the relief of pain. Conditions such as diabetes should be looked for, and appropriate treatment instituted.

It is now necessary to consider the individual varieties of gangrene according to their ætiology, and to discuss the further treatment of each form. This consideration resolves itself, in the main, into answering the questions if and when amputation should be done, and at what level. The following classification, it should be explained, is adopted for convenience in considering treatment ; it has no pretence to other value.

(1) **Gangrene from Direct Crushing.**—When dealing with a severe crush of a limb the first duty of the surgeon is to decide upon the necessity or otherwise of a primary amputation.

It need here only be said that while every endeavour is to be made to save a damaged limb, it must not be forgotten that with the onset of gangrene very virulent septic processes will take place in the crushed tissues, and the spread of these, even apart from causing direct danger to the patient's life, may lead to the necessity of amputation at a higher level than would have been called for had removal of the limb been performed at once. When gangrene is actually present, the limb should at once be amputated as close to the damaged part as is possible, having regard to the necessities of adequate flaps, a useful stump, and the avoidance of cutting through infected tissues.

(2) **Gangrene due to Mechanical Obstruction of a Main Arterial Trunk.**—When gangrene is threatened from this cause, every endeavour is to be made to remove all obstacles to the flow of blood to the limb beyond the obstruction. If an artery has been ligatured, care should be taken that the bandages are not unduly pressing on the possible collateral channels. If an artery has been ruptured, the effused mass of blood will not only be pressing on the collateral channels, but also on the main vein; turning out clot and ligaturing the artery may here relieve pressure, restore the circulation and save the limb. When an artery is pressed upon by the displaced end of a fractured bone, re-position of the fragments may allow the circulation to be continued. When the improper application of splints and bandages has obstructed the arterial channels, their removal may not be too late to prevent gangrene. After attempting by these means to remove the cause, the general and local treatment above described is carried out, and a line of demarcation is awaited. Amputation is then performed at the nearest possible level which will give a serviceable stump. Should sepsis occur in the gangrenous portion and spread rapidly, the surgeon is driven to amputate at once. No line of demarcation has formed. He must, therefore, remove the limb where the circulation can be found to be adequate and well above the limit of the septic processes. Such an untoward event, therefore, as the occurrence of sepsis may lead to much unnecessary sacrifice.

(3) **Gangrene due to Sudden Obliteration of the Main Arterial Channels by Embolism or Thrombosis.**—Such a condition as this occurs in endocarditis, in atheroma of vessels and after acute infective fevers—typhoid in particular. The resulting gangrene is sometimes of the dry variety, sometimes moist. In the former instance the mode of treatment called for is that described for senile gangrene; in the latter, the treatment is identical with that just described as applicable to cases of similar obliteration from mechanical causes.

(4) **Gangrene due to Gradual Obliteration of the Main Arteries.—Senile Gangrene.**—Senile gangrene is dry, and is usually limited at first to a single toe. The progress of the

gangrene is very gradual, and the general condition of the patient may for some time be unaffected by any septic absorption from the dead part. On the other hand, pain is often severe, gangrene is likely to spread beyond the line of demarcation, and repeated unsuccessful attempts at spontaneous separation may result in the extension of the gangrene to the foot or leg. Meanwhile, the onset of toxæmic symptoms, combined with the effect of pain and exhaustion, may threaten the patient's life. Until comparatively recent years it was the accepted practice of surgeons to leave such cases for spontaneous amputation to take place, at most snipping through a dried-up tendon or assisting the separation of the remains of a bone. Attempts at amputation resulted almost invariably in gangrene of the flaps rapidly spreading above the line of operation. Two causes contributed to this result. In the first place, before the Listerian era suppuration ensued as a matter of course and the results were disastrous in the ill-nourished and anæmic tissues of the subject of senile gangrene. In the second place, it was not clearly recognised that the circulatory conditions present rendered futile any attempt at amputation in the neighbourhood of the dead part. In some cases the expectant line of treatment was effectual, and the patient recovered with the loss of a great toe, and remained in comparative comfort for years afterwards. On the other hand, in many cases spontaneous separation failed to take place; gangrene spread further and further up the limb, and, after months of suffering, death ensued.

The advent of antiseptic surgery has changed this, and early amputation is now successfully practised in the treatment of senile gangrene. At the same time it must be recognised that there are cases where the gangrene is limited to the terminal phalanx of the great toe, possibly on both sides, where amputation, which if performed at all must be at a high level, is unnecessary. If the gangrene is limited to a single toe, the precautionary measures of disinfection described at the beginning of this article are rigorously to be carried out. Rest is ordered, and suitable general treatment is given. Pain is met by the administration of opium, which is claimed by many to have a beneficial effect in senile gangrene, as certainly it has when diabetes is present. In a certain number of cases spontaneous separation, carefully and sparingly assisted by the surgeon, takes place. When once the gangrene has spread beyond the limits of the toe, and is affecting the sole or dorsum of the foot, or when sepsis is spreading from the dead part and pus is burrowing into the foot, further delay is useless and dangerous. Amputation should be performed. It only remains to discuss at what level this should be done. Most surgeons are agreed that the amputation should take place at or near the knee-joint. It is objected to amputation at the joint itself that the flaps, being long and ill-nourished, are likely to slough in a patient with an already inefficient circulation. The writer's experience has persuaded him that such fears are not well founded, and the rapidity with which the operation is performed and the avoidance of the danger of bone infection are points in its favour. On the other hand, it is undoubted that amputation through the femur, close above the condyles, gives a more useful and manageable stump, and provided that the general condition of the patient is satisfactory, it is the operation of choice. Amputation below the knee-joint has no advantages to compensate for the risk of gangrene occurring in the stump. It is impossible to be certain that the vascular supply is efficient at a lower point than the knee-joint where collateral channels are plentiful and anastomosis is free.

(5) **Diabetic Gangrene.**—The gangrene is not directly dependent upon the disease, but upon the arterio-sclerosis to which it gives rise. In general terms, therefore, the condition is similar to senile gangrene, but the presence of sugar in the tissues renders these more prone to infection. Diabetic gangrene spreads more rapidly than senile gangrene, and even when originally of the dry variety tends to become moist. Moreover, there is the added danger of a development of diabetic coma either in the course of the disease or following upon operative treatment. The remarks made, in dealing with senile gangrene, as to the changes in the accepted treatment made in recent years hold good here also. When the gangrene is limited to a single toe, or to a small area of skin, expectant treatment is permissible. When, however, the gangrene has spread to the foot, or when septic complications are present, the question of amputation must immediately be considered. The danger of post-operative coma is a real one, but in a bad case of diabetic gangrene coma may ensue at any time, and the disease is certainly soon fatal if nothing be done. The amount of sugar present in the urine appears to have little influence on the likelihood of coma ; the presence of such bodies as acetone, diacetic acid and oxybutyric acid, on the other hand, is of considerable moment. Whilst it is not possible that exact limits can be placed as to what constitutes a dangerous amount, yet it may be said that a high percentage of these derivatives is a warning not to be disregarded. If amputation be decided on, it

should be performed at or immediately above the knee-joint. A time should be chosen when the excretion of sugar and acetone derivatives is at its lowest, and appropriate diet should be given to bring about this result. Ether is a safer anæsthetic than chloroform, which appears to favour the production of the derivatives mentioned. Large amounts of sodium bicarbonate (half-drachm doses with an equal amount of sodium citrate every two hours) should be given until the urine is strongly alkaline, as a prophylactic measure. The operation should be performed as expeditiously as possible, and the most stringent aseptic and antiseptic precautions are needed.

(6) **Raynaud's Disease.**—It is only comparatively rarely in this disease that gangrene actually ensues. Treatment is usually called for on account of recurring spasmodic attacks of arterial contraction, giving rise to the characteristic phenomena of pallor, followed by congestion and œdema. The condition is often associated with hysteria and uterine troubles are not infrequently present. Treatment is general and local.

General Treatment.—Suitable measures must be directed towards the treatment of any hysterical element in the causation. Tonics, open air and exercise are called for, and in some cases a course of Weir-Mitchell treatment is advisable. Quinine, strychnine and arsenic are the three drugs most commonly employed. Attempts by means of amyl nitrite or liquor trinitrini to relax the vessels, though promising on theoretical grounds, have failed in practice. Adequate protection against exposure to cold must be taken, for although Raynaud's disease does occur in the summer, it is, generally speaking, an affection of the cold season.

Local Treatment.—The constant current appears to be the most effectual means at our command. It should be employed in the form of an electric bath, one electrode being applied to the upper part of the limb, the other being placed in the saline solution in which the extremity is immersed (*see* Electro Therapeutics, Vol. III.). Massage of the limb should be carried out in conjunction with this. It must be gently applied, and at first a soft wash-leather glove must cover the operator's hand. With perseverance the amount of massage may be increased from day to day, and the complaint of pain becomes less as the patient becomes accustomed to the process. Where the skin is intact and the patient can bear it, compound camphor liniment may be rubbed in. Recently treatment by Bier's method, both by the hot-air douche and by passive congestion, has been recommended. When once gangrene has taken place the part should be carefully disinfected in the way already described, dried, dusted with a dry antiseptic powder and enveloped in a dressing of sterilised wool. Separation of the dead part is then awaited, and although it may seem at first that the whole hand will be lost, experience has shown that the extent of gangrene is practically always limited to a small superficial part of the skin and subcutaneous tissues. As a rule of practice it may be said that amputation is never called for.

(7) **Ergot Gangrene.**—Although prevalent in the past, ergot gangrene, in this country at any rate, must be looked upon as a surgical rarity. It is due not to the taking of the drug but to the use, as an article of diet, of bread made from rye infected with the Claviceps Purpurea. The first essential in the treatment is to remove the cause. The bread should be examined for the presence of the fungus, and the use of any affected bread should be abandoned. Locally, warmth, massage and rest may restore the circulation in the early stages; stimulants are given, and coffee is thought especially serviceable. If gangrene ensues it is usually of the dry variety, and a definite line of demarcation may be expected beyond which gangrene is not likely to spread. Amputation may, therefore, be safely performed close to the edge of the dead part.

(8) **Carbolic Gangrene.**—A large number of cases have been recorded of gangrene, usually of fingers or toes, following upon the use of dressings soaked in a solution of carbolic acid. Although in most cases a 5 per cent. solution has been responsible, in other cases a solution as weak as 1 per cent. has produced gangrene. The treatment is obviously in the first place prophylactic. Should gangrene be present, a line of demarcation is awaited, and as little of the finger or toe sacrificed as possible.

(9) **Specific Gangrenes.** — (*a*) *Acute Spreading Traumatic Gangrene.*—This desperate and almost inevitably fatal condition is now practically never seen. The treatment is prophylactic, and consists in the careful disinfection and cleansing of crushed limbs and wounds infected with soil. The fact that the disease has been almost abolished shows how effectual this prophylactic treatment has been. Should such a condition develop, amputation should immediately be performed as far as possible from the affected part, every precaution being taken to avoid infection of the site of amputation, which constitutes the chief source of danger.

(*b*) *Cancrum Oris and Noma.*—These conditions, whilst rare, are still met with in debilitated children following upon one of the acute exanthemata, usually measles. Prompt treatment is needed if the child's life is to be saved. An anæsthetic having been given, the whole of the gangrenous part is cut boldly away with the knife, without regard to anatomical considerations and without regard to the deformity which will be left. The complete removal of the gangrenous mass may need the removal of some part of the jaw, and the process should everywhere be continued until a healthy bleeding surface remains. The raw area is then thoroughly cauterised with fuming nitric acid, the action of which can be stopped, when the desired effects have been attained, by the application of a solution of soda. In milder cases liquid carbolic acid may be substituted for nitric, and some surgeons prefer to carry out the whole destruction of the affected tissues by means of Paquelin's cautery. Constitutional treatment is of great importance, diet must be suitable, and free stimulation is necessary. No drugs have a specific effect.

MAYNARD SMITH.

GLANDERS.

Glanders in man is a specific infectious disease, occurring as a direct result of the inoculation of the bacillus mallei. Infection usually takes place from the horse, mule or donkey, either by direct contact or by inoculation of a cut or cutaneous abrasion with material charged with the specific micro-organism. The disease may assume either an acute or a chronic form.

Diagnosis.—In acute glanders the services of a competent and "licensed" bacteriologist are required. Some of the purulent discharge, either from the nose or from the large "rupia-like" eruptions should be collected on a sterile swab, the bacillus isolated and the results confirmed by the inoculation test. This animal inoculation test is essential, as it is sometimes exceedingly difficult to obtain pure growths of the organism from the pustules, hence an accurate diagnosis is often impossible in any other way. To the skilled eye, however, the appearance of the nuclear detritus in the films prepared from the original infected pus is usually quite sufficient to enable the bacteriologist to make a provisional diagnosis quite accurately enough to warrant instant isolation of the patient, and immediate precautions being taken with regard to the prevention of infection.

In chronic glanders in which there is usually no initial skin lesion, or obvious wound, diagnosis is often a matter of still greater difficulty. The appearance of a group of papules or pustules may be the first thing noticed, or perhaps the formation of a few intramuscular or periosteal abscesses associated with vague joint pains and some intermittent fever. Frequently the local lesion results in the formation of an angular ulcer with thickened edges and foul smelling discharge. Such ulcers are commonly observed on the forehead and cheek, and the pus from these areas will usually enable identification of the glanders bacillus to be made. In difficult cases Sir John McFadyean recommends the application of the agglutination test. This test, however, is not free from technical objections and fallacies.

Differential Diagnosis.—Syphilis and tuberculosis are two conditions which may render diagnosis difficult. The existence of the former affection is decided by the Wassermann reaction, and the latter either by microscopical examination of the pus, by the use of the tuberculin test, or by the serial examination of the tuberculo-opsonic index. The Grünbaum-Widal reaction test should be applied to those cases in which it is desirable to eliminate enteric fever.

Incubation Period.—This is very variable. In acute glanders the period may be only from three to six days, whilst in the chronic form it may be considerably prolonged, and even extended to six days more. As a rule, those cases associated with an incubation period of less than eight days are attended by a fatal issue within three weeks.

Acute Glanders in man is almost invariably fatal. The patient should be isolated at once, and rigid discipline insured to prevent attendants becoming infected and danger arising from the sheets, dressings, etc., contaminated by a patient, as the disease is highly contagious. The cutaneous abscesses almost always contain pyogenic cocci associated with the glanders bacillus. These areas of infection should be opened and drained, and the usual antiseptic treatment applied. Local symptoms should be treated as they arise.

Chronic Glanders.—Complete isolation of the patient, provision of plenty of fresh air, comfortable apartments, and an abundance of good food are imperative. Local abscesses should be curetted, whether in the nasal passages or elsewhere, kept scrupulously clean, and treated with the usual antiseptic lotions.

Patients' friends should be warned that these cases usually run a very long and irregular course, sometimes for a year or more, and that when recovery seems complete fresh ulcers and abscesses may appear, which break down, indicating that the disease is still active.

Attention should be paid to the destruction by cremation of all dressings containing nasal or other discharges, as they form a source of great danger to the nurses and those who come into contact with the patient.

So far as regards treatment, the use of a serum derived from an artificially immunised animal is of little value, as it possesses only very slight immunising properties of a transitory nature. Further experience is necessary before the treatment of cases of chronic glanders with a vaccine can be justifiably recommended.

The mortality in chronic glanders is great, and certainly from 40 to 50 per cent. of all cases have a fatal issue.

HAROLD SPITTA.

GONORRHŒA.

Gonorrhœa is due to the infection of the mucous membrane of the urethra or vagina with the gonococcus, and manifests itself as a purulent discharge in which that organism is present in large numbers. The infective process spreads backwards from the meatus, and may extend to the prostatic urethra in from seven to fourteen days, so that an anterior and a posterior form of gonorrhœa are described. When situated in the anterior part of the urethra the process is a local one, but when it has attained the prostatic urethra it may spread to adjacent organs, such as the bladder and epididymis, and may become generalised in the system and manifest itself in inflammations of joints, of serous membranes and fascial structures. From this it follows that, if the case is seen shortly after its commencement, the primary aim of treatment should be to prevent the infection from extending backwards, and so render it incapable of producing any serious complications. The one substance which most rapidly effects the destruction and disappearance of the gonococcus is nitrate of silver, but its solutions if introduced into the urethra as injections are liable to set up an acute inflammatory reaction. Consequently many modifications of nitrate of silver have been devised which, whilst being destructive of the gonococcus, will not be so injurious or so irritating to the urethra; amongst these are protargol, nargol, argentamin, argyrol, albargin, argonin and ichthargan.

The abortive treatment may be carried out in the following manner; the urethroscopic tube is passed beyond the inflamed area, and down it is inserted a stilette to the end of which a small pledget of cotton wool is attached; this is soaked in a solution of nitrate of silver (gr. 10 ad gr. 20 ad ℥j), and the anterior urethra is thoroughly swabbed out from behind forwards, or a 10 per cent. solution of one of the above-mentioned substances may be used in the same manner. This procedure is followed by pain and by a copious purulent discharge, which however should gradually diminish both in amount and in purulency and disappear in from four to six days, during the greater part of which time the patient should be confined to his room.

It was formerly the custom to commence the treatment of gonorrhœa by administering alkalies and vesical sedatives, such as buchu, uva ursi, and hyoscyamus until the ardor urinæ was considerably abated; this delay in the commencement of local treatment enabled the gonococcus to reach the posterior urethra, from which it can only with difficulty be dislodged. Every case of gonorrhœa when first seen should be treated with injections or irrigations. and at the same time medicinal treatment must be employed with a view of relieving the pain. A 1 per cent. solution of one of the silver preparations enumerated above may be used in the following manner. The bladder being first emptied, the nozzle of the urethral syringe containing the solution should be introduced into the meatus urinarius, and the contents of the syringe slowly pressed into the urethra, until that tube is thoroughly distended. The solution should be retained in the urethra for five to fifteen minutes, the time varying in proportion with the severity of the case, and the tolerance of the patient; the injections should be used three or four times a day. When the acute stage is subsiding the injections may be made from behind forwards by introducing a tube as far as the bulbous portion of the urethra; the syringe is then connected with this tube, and the solution being thereby introduced will flow forwards and escape from the meatus. Another form of treatment is by urethral irrigations; in this method the urethral tube instead of being connected with a syringe is attached to an irrigator, so that the anterior urethra can be thoroughly washed out from the bulb to the meatus by weak astringent or antiseptic solutions, such as permanganate of potash, sulphate of zinc or alum. A somewhat similar procedure is known as Janet's method, in which the resistance of the compressor urethræ is overcome by the force of the fluid introduced by the irrigator, so that the bladder is filled and the solution subsequently expelled; this form of treatment cannot be entrusted to the patient himself, but has to be carried out by the surgeon. Frequent examinations of the discharge for the presence of the gonococcus should be made, and the disappearance of that germ is an indication to substitute astringent injections for the silver preparations. The following astringent solutions may be recommended: Permanganate of Zinc, gr. ⅛ ad ʒj; Zinci Sulphatis, gr. 2 ad ʒj; Zinci Sulphocarb., gr. 2 ad ʒj; Zinci Chloridi, gr. ½ ad ʒj; a combination of the Sulphates of Zinc, Iron, Alum and Copper, āā gr. 10 ad ʒviij (dilute with three times the quantity of water, and gradually increase the strength), or the Injection Brou of the French made up according to the following formula: ℞. Opii, gr. 3; Catechu, gr. 3; Croci, gr. 6; Aq. Bullientis, ʒijss; *infuse, filter and add* Plumbi Acetatis, gr. 10; Zinci Sulphatis, gr. 15; *misce; ft. injectio.*

As adjuncts to the local treatment saline aperients should be given, and urinary antiseptics and balsams, such as salol, urotropin, piperazine, helmitol or capsules of copaiba, cubebs, sandal-wood, thyresol and gonosan, the latter being a combination of ol. santal. flav. (3 min.) and of resin kava kava (gr. ½). The diet should be light and simple, and highly seasoned dishes, shellfish, asparagus and coffee should be avoided. No wine, beer or spirits should be taken, though large quantities of non-alcoholic liquids should be consumed, such as barley-water, soda-water and milk, Evian or Vichy waters.

Treated on such lines as these many cases can be conducted to a satisfactory conclusion, but in a certain proportion the disease becomes located in the prostatic urethra, and is consequently not influenced by ordinary urethral injections, which are unable to pass beyond the compressor urethræ muscle. Under these circumstances injections may be given by means of the urethral tube, or small quantities (20 min.) of a solution of nitrate of silver (10 or 15 gr. ad ℥j), may be instilled into the prostatic urethra; care must be taken that these instillations do not reach back to the neck of the bladder, since they are then liable to be instantly expelled. Conditions may be present in the anterior part of the urethra which may conduce to the long continuance of the discharge, and which may be ascertained by urethroscopic examination, *e.g.*, stricture of the urethra, granular patches, or follicular urethritis when the gonococcus effects a lodgment in the follicles of the urethra; in all these conditions, recourse should be had to the passage of a large bougie, and the affected area may be painted over with a solution of nitrate of silver applied down the urethroscopic tube.

Cases will be encountered which give no response to any of the plans of treatment above advocated, and in these the administration of **vaccines** may be tried, small doses of stock vaccine being administered at frequent intervals. The vaccine treatment is indicated in the later phases of the disease, and in the presence of some of the obstinate complications which may then be encountered, such as epididymitis, arthritis and iridochoroiditis; in these conditions rectal injections of antistreptococcic serum have also proved successful (*see* Vaccine Therapy, Vol. III.).

COMPLICATIONS.

In the course of the disease numerous complications may occur which will call for special measures of treatment.

Œdema of the Prepuce may be met with early and may give rise to phimosis, a condition which should be treated by the application of lead and opium lotion, by multiple punctures with a needle, and may even call for a dorsal incision through the prepuce or circumcision.

Acute Lymphangitis is another early complication which manifests itself by the presence of a hard, painful and reddened cord on the dorsum of the penis, with which will often be associated some tenderness of the inguinal glands. The treatment of this condition is by rest, purgatives, hot fomentations, and, if abscess occurs, by incision.

Chordee and Painful Erections may be treated by cold applications, by suppositories of opium and belladonna, or by a mixture of bromides with liquid extract of salix niger.

Gonorrhœal Warts may occur on the glans penis, in the furrow or on the inner surface of the prepuce. Since their growth is encouraged by moisture, they should be treated by a desiccating powder, such as alum and savine in equal parts; if they do not respond to this treatment, the application of caustics, such as nitric acid or glacial acetic acid may be required. If there is a co-existing phimosis, circumcision should be performed, and the exposed vegetations removed with scissors.

Peri-urethral Abscess may be met with in any portion of the corpus spongiosum urethra, and will require incision and drainage, a treatment which will also apply to abscess of Cowper's glands.

In **Acute Prostatitis** the patient should be confined to bed and should have a calomel purge ; hot fomentations should be applied to the perineum ; in a robust patient six or eight leeches may be applied to the perineum, and the patient may subsequently be placed in a hot hip bath ; to relieve the pain, suppositories of opium and belladonna may be administered. Should a prostatic abscess ensue the collection of pus may possibly be evacuated by the passage of a catheter, which will be necessitated in order to relieve the retention of urine, which is usually the accompaniment of this condition, or the abscess may require to be opened by a perineal incision.

Chronic prostatitis is a common sequela of gonorrhœa, and is a frequent cause of recurrent attacks of the urethral discharge, the gonococci becoming lodged in the ducts of the prostate escaping periodically into the urethra and reinfecting its mucous membrane. It is usually accompanied by considerable mental and bodily depression and its subjects become nervous and hypochondriacal. It may be treated by the passage of full-sized bougies, Nos. 23 to 28 French gauge, by digital massage of the prostate through the anterior wall of the rectum, a procedure which will usually cause the escape of a certain amount of the prostatic secretion into the urethra; then instillations of small quantities of a solution of nitrate of silver (gr. 10 ad 1 oz.) may be made into the prostatic urethra by means of a Guyon's syringe. The mental depression may be remedied by the administration of a tonic, such as the compound syrup of glycerophosphates.

One of the most formidable complications of gonorrhœa is **Epididymytis**, since this condition, if bilateral, is one of the commonest causes of sterility, through occlusion of the tubes of the epididymitis. If possible the patient should be confined to bed, the scrotum should be raised on a pillow placed between the thighs, and glycerine and belladonna should be applied thereto.

The applications of a "Jullien's" suspensory bandage will at once relieve the pain, and will cause a gradual subsidence of the swelling; this contrivance resembles the ordinary suspender, but the scrotal bag is larger, and is composed of waterproof material; this is padded with layers of cotton-wool and is retained in position by abdominal and perineal straps, whilst its tightness can be regulated by lateral tapes; it entails pressure, heat and moisture, the most efficient means available for promoting the absorption of inflammatory products.

Instillations of nitrate of silver solutions into the prostatic urethra are the best means of preventing the infection spreading to the other testicle. It has also been recommended to make an incision over the infected organ, and to cut through the parietal layer of the tunica vaginalis; multiple punctures are then made into the tunica albuginea, and any minute collections of pus in the epididymis are evacuated and the cavities disinfected with perchloride of mercury lotion. This treatment is said to relieve the pain, and to insure the rapid disappearance of the inflammatory exudation, and so to prevent the subsequent loss of function of the testicle. A somewhat similar procedure is to puncture the epididymis with a needle attached to a morphia syringe and to aspirate the contents of any small abscess that may be encountered.

Seminal Vesiculitis, if acute, may be treated by hot or cold rectal irrigations and by opium and belladonna suppositories; if an abscess forms it should be opened by perineal incision. In chronic seminal vesiculitis, the distended vesicle may be emptied by massage through the anterior wall of the rectum, and the subsequent application of solutions of nitrate of silver to the prostatic urethra may relieve the condition.

From the prostatic urethra the infection may pass backwards to the bladder, and give rise to **Urethro-cystitis and Cystitis** of varying intensity. In acute cases the patient must be kept in bed and be given suppositories of opium and belladonna to relieve the pain and strangury; urinary disinfectants such as helmitol, urotropin or piperazine may be given, together with large quantities of barley-water, Contrexéville or Evian waters. During the subsidence of the inflammation and in the subacute cases the bladder may be gently irrigated with warm boracic lotion, and if the condition becomes chronic, irrigation of the bladder with weak solutions of nitrate of silver (1 in 10,000) may be resorted to (*see also* Diseases of the Bladder, Vol. II., and Diseases of the Male Genital Organs, Vol. II.).

Gonorrhœal Rheumatism is another of the complications which may occur when the disease has reached the posterior urethra, and is due to an infection of the blood with the gonococcus or its toxins; it affects the joints and peri-articular structures, fasciæ, bursæ and tendon sheaths. The first aim of treatment is to get rid of the gonococcus from the urethra, and so to abolish the source of the infection; instillations of solutions of nitrate of silver should be made to the prostatic urethra, and if the anterior urethra be still involved treatment by injections must be continued. The joints or other parts affected should be kept at rest and subjected to cold applications locally by means of evaporating lotions, Leiter's tubes or an ice-bag. Bier's method of passive congestion is applicable to this condition, and counter-irritants such as blisters, iodine, or the actual cautery may prove beneficial. Internally, salicylate of soda, aspirin, iodide of potassium, and large quantities of fluid may be administered. In chronic cases the affected part should be treated by radiant heat, iodine kataphoresis and massage, and if the condition does not yield to these measures, vaccines or antistreptococcic serum should be employed.

Gonorrhœal Ophthalmia is caused by inoculation of the conjunctiva with the gonococcus, and may be met with in adults or in children, as in ophthalmia neonatorum, though all cases of this condition are not necessarily of gonococcic origin. Since the process is such a rapidly destructive one, the treatment requires to be prompt and energetic. In the early stages cold compresses should be applied over the affected eye, which should be freely and frequently irrigated with a weak antiseptic lotion, such as sol. hydrarg. perchlor. (1 in 10,000) or boracic lotion. To relieve the pain one or two leeches may be applied close to the outer angle of the orbit. Later, the whole surface of the conjunctiva should be painted once daily with a solution of nitrate of silver (10 gr. ad

1 oz.), avoiding the cornea, and frequent irrigations continued with a weak antiseptic lotion, to prevent any discharge from accumulating; as a substitute for the nitrate of silver, a 25 per cent. solution of protargol may be employed, a far less painful procedure. The subjects of this condition are usually in a state of both bodily and mental depression, and will require tonics, such as quinine and strychnine, and small quantities of stimulants. The patient must be warned of the danger of the contagion being conveyed to the sound eye, which should be protected by a "Buller's" shield.

The subjects of gonorrhœal rheumatism are liable to attacks of serous iritis of a somewhat obstinate character, and very liable to recur. The treatment for this condition should be by atropine and cocaine locally, and internally by salicylates and iodides (*see* Diseases of the Eyes, Vol. III.).

In women gonorrhœa may attack the vulva, the urethra or the vagina, whence it may spread to the uterus, the Fallopian tubes, and even to the peritoneal cavity. In gonorrhœa of the vulva the pain and irritation are much relieved by occasional immersions in a hot hip bath, and lint saturated with lead and opium lotion may be placed between the opposed surfaces of the labia. During the subsidence of the inflammatory process, the affected surfaces may be painted over with a solution of nitrate of silver and astringent vaginal injections administered. Gonorrhœa of the vulva usually spreads to the urethra, in which case severe ardor urinæ will be experienced; this may be relieved by mixtures of alkalies and hyoscyamus, and the urine should be diluted by the administration of large quantities of bland fluids such as barley-water; if the pain on urination be intense, it may be necessary to cocainise the urethra. When the acute urethritis has subsided, copaiba, cubebs or sandal-wood may be given internally, and the urethra may be swabbed out with solutions of nitrate of silver applied down the urethroscopic tube. Vaginal gonorrhœa may in its initial stages be treated by frequent douching with hot water, and as soon as the patient can tolerate the passage of the speculum, the vagina should be swabbed out with a strong solution of nitrate of silver (20 to 30 gr. ad ʒj), and a glycerine tampon subsequently introduced. This procedure should be repeated at intervals of from four to six days, and probably at least three such applications will be necessary in order to check the spread of the gonococcus; in the intervals astringent injections of alum, lead, permanganate, sulphate or sulphocarbolate of zinc should be employed.

Labial abscess is due to the gonorrhœal infection spreading to the glands of Bartholin, and will require free incision and plugging with iodoform gauze; in the event of the abscess recurring, removal of the gland is indicated. Gonorrhœal warts or vegetations frequently attain to a great size in women, and may require removal either by means of the knife or the thermo-cautery (*see* Diseases of Vulva and Vagina, Vol. IV.).

J. ERNEST LANE.

INFLAMMATION.

It is unnecessary to discuss at length the general treatment of inflammation, for its various phases are dealt with in detail under their appropriate headings. A short reference, however, will be made to the more important principles.

Acute Inflammation.—In the first instance treatment should be directed to the *removal of the cause*, whenever this is practicable: for instance, an alveolar periostitis may be at once relieved by the removal of the offending tooth. In most cases, however, the presence of certain micro-organisms is the exciting cause of the inflammation, and direct removal is impossible. It is therefore essential to ascertain the nature of the infecting organism by bacteriological examination, in order to be able to assist the natural resisting powers of the tissues by suitable vaccine or serum treatment if necessary.

Rest of the inflamed part is of supreme importance, and is often not sufficiently insisted upon: *e.g.*, inflammatory troubles of the breast will yield more quickly to treatment, if the underlying pectoral muscles are rested by fixation of the arm with a bandage or sling; inflamed joints will at once improve if immobilised on a splint. The position of greatest comfort should as a rule be chosen; and, if a limb is the seat of inflammation, it should be elevated.

Heat is the most useful and comfortable form of local treatment. It is best applied in form of boracic fomentations, or as hot lead and opium lotion: ℞ Extract Opii Liquidi ʒij., Liquoris Plumbi Subacetatis ℥ss, Aquam Destillatam ad Θj. Poultices have the disadvantage of being septic and heavy; a well-made fomentation should be as hot, and retain the heat as long as a poultice.

Cold has a much smaller range of utility than heat; it is chiefly of value in mild and early forms of inflammation, and should be avoided in the young and the old, as it is liable to cause sloughing of the skin. It may be applied in the form of ice, evaporating lotions or Leiter's tubes. The following is a good evaporating lotion: ℞ Ammonii Chloridi ℥j, Acidi Acetici Diluti ℥ij, Spiritus Rectificati ℥ij, Aquam Destillatam ad Θj. *Free incisions* are indicated when the local tension is great, and when there are reasonable grounds for believing that suppuration is commencing. It is often difficult to decide whether the formation of pus has commenced; speaking generally, the following symptoms and signs indicate the presence of pus and the need for incisions: (1) continued pain and elevation of temperature; (2) insomnia; (3) failure of symptoms and signs to resolve under appropriate treatment, and (4) œdema.

As regards *general treatment* it is usually advisable to give a brisk mercurial purge (*e.g.*, Calomel 3 to 5 gr.) at the outset; free action of the bowels is subsequently maintained by the use of saline aperients. Food should be restricted to fluids, and should be given very frequently. Imperial drink or other bland fluid should be taken freely, in order to promote diuresis. Stimulants are often required and may be given freely, if necessary. Of drugs quinine is the most generally useful: in the stenic type of inflammation small doses of aconite are sometimes of value to lower the temperature and pulse rate. Analgesics, such as aspirin, phenacetin or Dover's powder (10 gr.), will do much to lessen the patient's discomfort.

In Chronic inflammation similar principles hold good; the cause of the inflammation is more often removable, and this should be done as early as possible. Rest is as important as in the acute forms, and *counter-irritation* is of great value. An effectual method of applying counter-irritation is by means of a Scott's dressing: Scott's ointment (Unguentum hydrargyri co.) spread on strips of lint is laid over the part, and over this strips of plaster are firmly applied. In this way counter-irritation and pressure are combined; the dressing may be removed in seven to ten days and again reapplied if necessary.

To restore the part to its natural condition and to remove the adhesions, etc., resulting from the inflammation, *massage* is of great value; potassium iodide is also beneficial in many cases of chronic inflammation besides those due to syphilis.

Vaccine therapy is applicable in many cases, and should always be taken into consideration. *Bier's hyperæmic treatment* for both chronic and acute forms of inflammation has not received the recognition in this country that it deserves. The indications for these forms of treatment and the methods of application are described in Vol. III.

C. H. S. FRANKAU.

INFLUENZA.

INFLUENZA may be described as an acute fever of short duration, three to five days as a rule, of which the principal symptoms are pains in the head, eyes, lumbar spine or muscles, and acute aching of the limbs. The secondary symptoms are loss of appetite, thirst, restlessness, occasionally insomnia, and great sweating. An uncomplicated attack of the disease will run its course without interference from the physician in about the same time as a treated case; and in many cases there is a perfect recovery, although the patient has taken no care, has gone about his occupation and has exposed himself to the weather. This has been observed frequently in the case of nurses and servants who have been obliged to continue their work, and in business men for similar reasons. It therefore is incumbent on the physician in no way to encumber the path of beneficent nature, who will fight her way to victory by her unaided efforts; and no treatment must be followed which in any way risks the chances of recovery. This was observed in all the historical epidemics of the disease, and as early as 1660 Wierus (Amsterdam) wrote "only those died who were afflicted with some chronic disease, or *qui venesectione usi sunt.*" The treatment which is effectual in the great majority of cases is to keep the patient in bed, and to keep him on a light liquid diet while the fever lasts, and to relieve the pains by the administration of aspirin and phenacetin, or both combined. A useful prescription is the following: Aspirin, gr. 10; Phenacetin, gr. 5; Caffein. Citratis, gr. 2. This may be given in a wafer, and repeated every four hours, until the temperature descends to 99° to 100° F., which it usually does after twelve to twenty-four hours. Two to three doses generally remove all pain and give the patient a good night with sufficient sleep accompanied by profuse sweating and a feeling of rest and well-being which is marked the following morning. Sometimes this ends the attack, but more often the feeling of restored health passes off about midday and there is a return of similar but slighter symptoms during the afternoon, for which one or two powders will be required. After a good night the temperature will be again nearly normal, but will rise again in the evening somewhere between 99° and 100° F., and after that the disease will disappear.

During the intervals between the rises of temperature it is advisable to commence giving the patient some light solid food, bread and butter with an egg or a little white fish and vegetable, unless from the symptoms and signs indigestion is found to be present. Solid food is less constipating and less flatulent than liquid, and it is advisable to avoid constipation, for the treatment of constipation by purgatives has a lowering effect on the patient, and is apt to lead to complications owing to the danger of chill during the sweating which persists for some days. If a laxative has to be given it should be mild, and in ordinary patients in whom there is no sign of pre-existing intestinal stasis, a drachm of sulphate of magnesia or some similar salt in the early morning is most suitable.

This simple treatment is all that is required in nine-tenths of the cases of influenza, but there is a residuum of cases which will require some different management.

There are cases in which the temperature does not fall after four or five doses of the powder. Unless the powder does good at once, it will have little or no effect later, and this is equally the case when, after the initial fall, the temperature rises to its original height. Not more than six or seven powders should ever be administered, as there can be little doubt that phenacetin and aspirin are both in the long run depressants. It must be allowed that, except as mentioned above, no drug has any effect on the disease. Antipyrine, salicine, pyramidon and others of the same series, have a similar action, but have no advantage, while antipyrine has decided disadvantages, although it relieves the pain quicker than aspirin. Salicine has been given in 15-gr. doses every hour for eleven doses, and the rise (already described) on the second day has occurred with the addition of disagreeable symptoms due to salicism. Bicarbonate of potash in ½-drachm doses every two hours has a slower effect on the temperature, but generally relieves the pains within twenty-four hours.

When the temperature and other symptoms do not give way it may be taken that drug treatment is useless and is sometimes harmful, and if anything is given it should be in the nature of a placebo.

It can be said with certainty, but not without fear of contradiction, that alcohol is unnecessary as a cure for the disease, that small quantities, such as a moderate patient is accustomed to, are harmless, and that during convalescence it does stimulate the patient a little, and enables him to forget his aches and his depression for the time. To deny that alcohol makes a patient feel better would be as insane as to assert that it cures him, but it must always be remembered that "feeling better" is half the battle with a convalescent, and when this feeling can be procured by a glass of Burgundy or a couple of teaspoonfuls of brandy or whisky in a wineglass of soda-water at meals, it is unjust to a patient to deny it. But it should never be allowed to those of unstable nervous temperament or of alcoholic tendencies.

VACCINE TREATMENT.

During the last few years many cases of influenza in the acute stage have been treated by the writer with a stock vaccine.· The initial dose is 15 to 20 millions, repeated next day if required, but generally only one dose is necessary. This produces, as a rule, a fairly violent negative phase, during which the temperature may rise 2° to 3° F., and the pains and general distress be accentuated, but is followed in about two to six hours by relief, a quiet sleep and a rapid fall of temperature. If the patient after an efficient dose (not less than 15 millions) experiences no negative phase, or no relief, it may be pretty confidently stated that the disease is not influenza.

Here it may be observed that many attacks which simulate influenza in all its symptoms are not due to the influenza bacillus. Many of them are due to pneumococcus, some to streptococcus or bacillus septus, and perhaps some, but those usually of a milder type, are due to Micrococcus catarrhalis. This last organism, probably is the commonest cause of cases known as "influenza cold," and, "feverish cold," where the temperature seldom rises above 100° to 101° F. There are probably other germs which produce attacks of a similar character, and some cases appear to be caused by a mixed infection.

RELAPSE IN INFLUENZA.

This is fairly common and may arise without any assignable cause, but more often is produced by excessive exertion or exercise after an acute attack. The relapse generally comes on suddenly with a recurrence of the original symptoms and the course of the disease is very similar, but shorter than the first attack. It will be best avoided by keeping the patient at rest for a sufficient time after the subsidence of symptoms. No patient should be allowed out of bed until the temperature has been normal for twenty-four hours, and no exercise should be permitted for another twenty-four.

CONVALESCENCE.

The treatment of this is very difficult, and in many respects this stage is the most trying, both for patient and physician. With a fair appetite and good sleep the patient is generally feeling rather better in the morning before rising, but as the day progresses he feels depressed, weak, irritable and unable to concentrate his mind either on business or pleasure. He passes the day listlessly and miserably or tries to attend to his business and fails. Examination finds nothing amiss, and, except for profuse perspiration, his organs are acting normally. This neurasthenic condition may last a few days or may persist for months, and no treatment has much immediate effect. We are practically limited in our treatment to tonics and change of air, of which the latter is the more useful. Seaside or mountain air is indicated, and the following tonic will be of service, Liq. Strychnin., ʒj; Extr. Cinch. Liq. ʒij; Acid. Phosph. Dil., ʒij; Sp. Chloroform, ʒij; Aq. ad ℥vj; Sig. $\frac{1}{12}$ part three times daily after food [U.S.P. ℞. Strychninæ Hydrochlor., gr. $\frac{3}{8}$; Fluid Extract. Cinchonæ, ʒij; Acid. Phosph. Dil., ʒijss; Sp. Chloroformi, ʒjss; Aquam, ad ℥vj].

A detail in the management of this stage which will be found of great service is to shorten the day and lengthen the night. Breakfast should be taken in bed, and the midday meal should be the heavy one of the day. The patient should be encouraged to sit out of doors as much as the weather will allow and to move about a little from time to time, prolonged or fatiguing exercise (mental or physical) being avoided. He should return to bed at 6.30 or 7 p.m., and the last meal (a light one) should be taken in bed.

PROPHYLAXIS.

The physician will often be consulted as to the value of isolation in influenza, and he is probably safe in answering that isolation of a patient is useless. In the first place, patients remain infectious from one to three weeks, and sometimes longer, after the fever has left, and in addition some patients may fairly be called "influenza carriers." The disease is often so mild that other inmates of the house may have contracted it without its recognition, and furthermore, in times when it is prevalent, a healthy person cannot hope to avoid infection unless he be isolated himself. Prevention of spread of infection depends on isolating the uninfected and not the infected—institutions may sometimes be kept free from the disease by this method—and the aged, the bronchitic and the consumptive should if possible be protected by keeping them away from influenza patients.

GASTRIC INFLUENZA.

This is a type of the disease not infrequently seen; it is probably due to an inflammation of the stomach wall from direct infection by the specific germ, and often spreads to the intestinal mucous membrane. The symptoms are vomiting and diarrhœa, the severity of which make a resemblance to cholera, for they may be almost continuous for from twelve to forty-eight hours, and produce a condition of collapse. In milder cases there may be only either diarrhœa or vomiting, sometimes vomiting lasts for some hours and is followed by diarrhœa. Pain is sometimes acute, but generally there is only abdominal soreness and some tenderness. If possible a dose of castor oil (not less than ℥ss) should be administered in all these cases; if it is retained a cure will generally be effected. Castor oil is well supported if taken in a wineglass of beer. After the oil has begun to act, five drops [U.S.P. eight drops] of tincture of opium or fifteen drops of chlorodyne should be given in cases where diarrhœa is severe. Abstinence from all food is absolutely necessary, and nothing should pass the mouth except a tablespoonful of water (at as infrequent intervals as the patient will submit to) to relieve thirst. The mouth, however, may be frequently rinsed with cold water or a mild antiseptic wash. This treatment should be commenced as early as possible after the symptoms have shown themselves, but must be employed even if the case is seen late, and will even then be efficacious. Twelve hours after cessation of symptoms food should be commenced, such as a little milk and soda or weak soup. In cases of mixed type, where there is slight general fever and much gastric disturbance, shown by very coated tongue, complete loss of appetite, nausea before and after food, and constipation, it is advisable to give a mild mercurial pill at night, such as: Pil. Hydrarg. gr. 3; Pil. Rhei Co., gr. ij.; [U.S.P. ℞. Massæ Hydrarg., gr. 3; Pulveris Rhei, gr. ½; Aloes Socotrinæ, gr. ⅓; Myrrhæ, gr. ⅓; Saponis, gr. ⅓; Ol. Menth. Pip., ♏⅓] followed by a mild saline in the morning. A gastric sedative should also be given three times a day, about fifteen minutes before food, such as: Liq. Bismuth, ʒss; Sod. Sulph., gr. 15; Tr. Gentian. Co., ʒj; Aq., ad ℥j. Later on a digestive tonic: Acid. Hydroch. Dil., ♏10; Tr. Nuc. Vom., ♏5; Aq., ad ℥ss; [U.S.P. ℞. Acid. Hydrochlor. Dil., ♏10; Tr. Nuc. Vom., ♏12; Aq., ad ℥ss] may be given immediately after each meal. If there is much flatulence and heartburn, the following mixture will be found of great value: Sod. Bicarb., gr. 10; Sod. Sulphocarb., gr. 15; Syr. Zingiberis, ʒss; Aq., ad ℥j; one dose after each meal.

CHRONIC INFLUENZA.

The bacillus once having effected an entrance into the tissues, the disease may not run the short but sharp course described above but may last three weeks, five weeks, seven weeks, and may eventually become chronic. All the ordinary treatments are unavailing, but the introduction of the vaccine treatment has given us a new and powerful weapon for combating the enemy. In one such case the patient's temperature varied from 99° F. to 100° F. every night for six months, and the patient remained permanently in a wretched state of health, although she eventually went about as much as her strength would allow her. She, some years later, died of acute pneumonia, but whether secondary to her influenza or not was never known.

Two other cases of chronic influenza are worth recording. A lady, sixty-six years of age, enormously stout, had suffered for three years from recurrent shivering and fever with severe chronic bronchitis. She had daily attacks of fever following a slight rigor in the morning, the temperature rising to 100° F. or 101° F. There was much cough with profuse dirty greenish expectoration and asthma and orthopnœa at night. Much depression of spirits and prostration of strength made life unbearable from what she called "fever and ague and bronchitis." The "fever" and "ague" she attributed to long residence in a malarious part of India where she had contracted it. These attacks would recur daily for some weeks at a time, would nearly disappear or become milder in summer, but persist during the winter. She was first seen in August, 1908, at the end of one of these prolonged phases; she remained free from fever, but suffered severely from asthma for two weeks, and then started a fresh phase, distressing cough, expectoration, daily fever, sleeplessness and anorexia. An examination of the sputum discovered a profuse growth of pneumococcus and influenza bacillus. A vaccine was made from both and she was regularly vaccinated; doses of 2 millions of each germ were given at first once a week. The doses were gradually increased up to over 200 millions and the patient lives now in fairly good health. She had a very severe attack of influenza in February, 1909, after an interval of three weeks without vaccination, and after being exposed for five days to infection from her attendant, who, although severely ill from influenza, continued to wait on her. Since that date she has not suffered.

A man, aged 48, had suffered from influenza for eight years; he was never more than a month free. He had been obliged to give up all work for a year, had travelled in the East, but on his return to England in June, 1908, his attacks returned, and he had six attacks between that date and the end of October when first seen. His attacks were of short duration, but were followed by great prostration of strength and depression of spirits even to suicidal tendencies. Vaccination, repeated every week for two months, and in increasing doses, and since then at irregular intervals, has restored him to health. This case brings out a curious point in the vaccination treatment, which is that in treating these chronic cases it is necessary to begin with very small doses. The patient was given for the first dose 10 millions which made him so ill for three days that he was with difficulty persuaded to continue the treatment. The initial dose should not have been more than 2 millions.

COMPLICATIONS.

No disease, except perhaps syphilis, is followed by more sequelæ and more varied than influenza, for there is no organ of the body and no tissue which does not at times seem to form a home for its bacillus. And no account of the treatment could be complete without referring to its commoner complications. Most cases at the onset have some catarrhal signs, slight *conjunctivitis* and *pharyngitis*, both of which are usually negligible, but when severe must be dealt with by ordinary measures. When *sore throat* is severe and the *glands of the neck* are enlarged, hot poultices or compresses, or a cold water bandage give relief, and a gargle such as the following: Sod. Bicarb., ʒj; Sod. Biborat., ʒjss; Glycerin., ℥j; Aq., ad ℥viij, acts as a mild astringent.

The inflammation often spreads to the *middle ear* without symptoms, but when earache supervenes a hot opium poultice changed every half hour, and fifteen or twenty drop doses of laudanum will afford what relief is possible. Sometimes the membranum tympani will rupture, and the discharge of a semi-sanguineous liquid will immediately take away pain. Care must be exercised to watch for *acute mastoid inflammation*, as shown by tenderness, for when this occurs reference should be at once made to an aural surgeon with a view to operation.

A distressing complication for which similar treatment is required is inflammation of the *frontal sinus*, but as with the ear trouble treatment is palliative. The pain sometimes passes off in a day or two, but sometimes persists for ten to thirty days. In two cases of long duration, which were seen this year, a culture was made from the nasal discharge, and in each case a cure effected in forty-eight hours. The influenza germ was not discovered in either case. The commonest of all the complications of influenza are bronchial catarrh, bronchitis and pneumonia. A very slight amount of *bronchial catarrh* is present in many cases and is practically negligible, but when it is accompanied by *tracheitis* or *laryngitis* it is at times made distressful to the patient by the peculiar, hard, almost dry paroxysmal cough, simulating that of whooping-cough, and known as the "influenza cough." It is a very difficult cough to relieve, but the drug which is found of the greatest use is heroin. This is usually administered in doses of $\frac{1}{12}$ gr., either in solution or pill form, which may be repeated if and as required four or five times during the twenty-four hours. If the bronchial catarrh extends further down the bronchial tubes it may give rise to any degree of bronchitis from the very mildest to the most severe, with deep congestion of both lungs and, especially in the very aged, of such a degree as to endanger the patient's life. Sometimes these lung complications arise from want of care during the attack, but it is not always so, for they are met with at the very commencement. In the early stages of these attacks, the most efficacious treatment is very hot poulticing or hot fomentations or cupping; and if there is much cyanosis or dyspnœa (*i.e.*, difficulty of inspiration) by the abstraction from the arm of 15 or 20 oz. of blood. What immediate and permanent relief this will give the patient no one who has not seen it can ever imagine. Inhalations every hour of steam from boiling water to which a little vinegar has been added (ʒj to Oj), or Friar's balsam [U.S.P. Tinct. Benzoin. Co.] (ʒj to ʒij to Oj) are found comforting, and internally a mixture such as the following: Vin. Ipecac., ♏5; Liq. Opii Sedativ., ♏8; Liq. Ammon. Acetat., ʒij; Aq. Chlorof., ad ℥j [U.S.P. ℞. Vin. Ipecac., ♏8; Liq. Opii Sedativ., ♏8; Liq. Ammon. Acetat., ʒij; Aquæ Chloroformi, ℥ss; Aquam, ad ℥j]. One dose every four hours. As a rule, the bronchitis tends to mend, and after a few days the expectorant and sedative medicine may be changed to a tonic mixture, and a morphine and ipecacuanha lozenge sucked occasionally for the relief of cough, or a pill or lozenge of heroin may be given.

Pneumonia shows itself in two forms as a complication of influenza. Either as the ordinary croupous pneumonia affecting one or both lungs, or as a broncho-pneumonia in which small disseminated patches of the lungs may be consolidated simultaneously or consecutively, and sometimes the inflammation will die out in one place to revive in another. The pneumonia will be treated in the same way as when it occurs as a disease *per se*, and the only advice which need here be given is that much greater attention should be paid to the condition of the stomach and bowels than is usually the case. "Look after the stomach and the pneumonia will take care of itself." No drug so far as we know will affect the inflamed lung, but a distended stomach seriously presses on the heart and impedes its action, and patients in pneumonia die from hear failure and not from suffocation. Whenever the stomach shows signs of distension all food, liquid or solid, should be stopped, and the patient kept alive on water. As a rule, patients will show no ill effects from this starvation, nor is this to be wondered at, when we know how little power of digestion the stomach retains in such conditions. As the influenza bacillus is the common cause of the typical influenzal broncho-pneumonia, it will be advisable to give a dose of 15 millions of influenza vaccine when the pneumonia is suspected, but it is not possible always to recognise this form early. If the pneumonia should be in the croupous form, 10 to 15 millions of pneumococcic vaccine should be given.

Heart affections are frequent complications of influenza. In children it will frequently be found that the heart becomes dilated during the period of fever. This is shown by enlargement of the dull area outwards and by the apex beat being found outside the nipple line. This enlargement exists on so many occasions with no ill effects following from it that it may be disregarded altogether, as it is found that in most cases it rights itself when the fever passes off, but in a few it persists into convalescence. When this occurs absolute rest is essential together with the exhibition of a strychnine tonic. With this treatment it seldom persists for more than a few weeks.

In adults dilatation of the heart is a more serious complication. In the writer's experience one of the most characteristic signs of influenza is the slow pulse of seventy to eighty or even less during the acute phase, and any rapidity of the pulse (say to over 100) should immediately excite interest and attention; and especially if the rapid pulse persists into the stage of convalescence or is produced by slight exertion (getting out of bed, etc.). Every patient's heart should be examined daily, and no patient should be allowed to get out of bed unless the heart's size is normal, except it has been known to be large beforehand. The dilatation of the heart shows itself by quickness and irregularity of the pulse, by the extension of dulness and by the displacement of the apex beat. When this occurs it is essential to keep the patient recumbent and administer a mixture resembling the following: Tr. Digitalis, Lig. Strychnin., āā ♏5; Aq., ad ℥j [U.S.P. Tr. Digitalis, ♏5; Strychnin. Hydrochlor., gr. $\frac{1}{20}$; Aq., ad ℥j]; three times daily.

Those who are not in the habit of making daily examination of the heart will find themselves responsible for medical disasters, including sudden syncope and cases of permanent tachycardia.

Amongst other complications of influenza may be mentioned *jaundice, nephritis, meningitis and neuritis*, the treatment of which is described under these headings.

Neuralgia is a frequent sequela of the disease, and its most common situation is the forehead (supraorbital). It often commences during the attack, but it does not reach its height until the patient is convalescent and able to get about. It then is quite periodic, being of extreme severity for a half to three-quarters of an hour at a time, perhaps once, perhaps twice in twenty-four hours. It is sometimes relieved by aspirin, phenacetine, antipyrine, or chloral hydrate in 5 or 10-gr. doses, but in the most severe cases, morphine becomes an absolute necessity. A tonic containing large doses of quinine seems to have the power of gradually removing the tendency to the attacks, and should be always prescribed: Quin. Sulph., gr. 48; Acid. Hydrochlor. Dil., ʒiv; Sp. Chlorof., ʒij; Aq., ad ℥vj [U.S.P. ℞. Quin. Sulph., gr. 48; Acid. Hydrochlor. Dil., ʒiv; Sp. Chlorof., ʒjss; Aq., ad ℥vj]; $\frac{1}{12}$ part three times daily after food.

H. A. DES VŒUX.

MEASLES.

General Treatment.—Measles is a disease the course of which is greatly influenced by the patient's surroundings. In the homes of the well-to-do it rarely gives rise to real anxiety; in those of the poor, especially in large towns, it is prone to be deadly or to be the cause of irreparable hurt to an important organ. The explanation of this difference is by no means to be found entirely in the fact that the one class of cases receives better nursing and medical attention than the other. Overcrowding and want of air and warmth are powerful factors towards severity of attack; and if these evils are present at home, it is better for the patient that he should be removed to a hospital. In a hospital ward it should be easy to keep the air at a temperature of 60° to 65° F., and at the same time to renew it frequently. So also should it be in a good-sized but perhaps not too large room in a private house. But where the rooms are small it is a good plan to set apart two for the patient's use, one for day and the other for night, so that each room in turn may get a thorough airing when unoccupied. It is true that the hospital ward has dangers which the well-to-do home has not; still they are dangers which are not always present, can with care be reduced to a low minimum, and are of less account than those due to insufficient accommodation at home. When an infectious children's disease is prevalent in the locality from which a children's hospital draws its patients, that disease will sooner or later gain an entrance to the hospital, and this is as true of fever as of general hospitals. Diphtheria and whooping-cough are especially fond of associating themselves with measles. There is also evidence to show that lobular pneumonia and stomatitis, two common complications, are with some ease communicable from one patient to another. Therefore patients suffering from or suspected to be suffering from one of these diseases or complications should not be placed in the same ward as uncomplicated cases, and every hospital in which measles is treated should be provided with the accommodation necessary for their separation.

Photophobia is common during the febrile stage, and it is necessary to shield the patient's eyes from direct light. The suitable disposition of the bed, or a screen placed between it and the window, will often be sufficient for the purpose. It is only in cases of severe conjunctivitis that it becomes necessary to darken the room. The patient should be confined to bed during the febrile period and for a few days after the temperature has settled to normal. He may then be allowed up in blankets or a dressing-gown, and in warm weather taken out of doors. In the majority of uncomplicated cases he will be well enough to be up and about in clothes towards the end of the third week from the onset of his illness.

Diet.—In most cases milk and water, 2 or 3 pints daily, will be sufficient nourishment during the febrile stage; but such foods as arrowroot, junket and jellies may be permitted if the patient cares for them. During this period some looseness of the bowels is often present and undigested food is found in the stools, in which case the milk should be peptonised or converted into whey. The patient is usually thirsty, and should be allowed to sip frequently water or lemonade, preferably prepared from fresh lemons. In severe cases there is often, even early in the illness, embarrassment of the respiration, and care should be taken not to increase this by overloading the stomach. Food and drink must be given in small quantities at frequent intervals. The rash and the fever usually disappear quickly and together; then, provided there is no looseness of the bowels, farinaceous food and an egg may be substituted for a portion of the milk. In two or three days fish and chicken may be added; and by the end of a fortnight in uncomplicated cases, the patient will be able to take his usual daily food.

Restlessness and Delirium during the febrile stage frequently call for treatment. These conditions are chiefly due to pyrexia or to the rash, which may be very irritating. Sponging the patient with water at a temperature of 85° to 90° F., every three or four hours, is the best treatment. If that fails to give relief, wet packs, in sheets wrung out of water at 85° F., applied for half an hour at intervals of four hours, should be tried. When the temperature is persistently over 103° F. cold water should be used for sponging. The writer has used iced water in such cases. But with children the application of cold water to the skin by these methods requires very careful watching for fear collapse should ensue, and it is advisable to administer a stimulant just before or during the treatment. These means are usually sufficient; should they fail, they may be supplemented by drugs, especially chloral hydrate, potassium bromide, or chloralamide, in doses suitable to the patient's age.

In many cases, for a day or two before the appearance of the rash, the patient is troubled with an irritating **laryngitis**, in which case the air about him should be kept moist with steam from a bronchitis kettle. If the symptoms are at all severe hot fomentations should be applied to the front of the neck. The cough will be relieved by an occasional drachm dose of a linctus composed of equal parts of compound tincture of camphor, [U.S.P. camphorated tincture of opium] oxymel of squill, and syrup of tolu. In a few instances it will be necessary to have recourse to surgical measures, in private practice tracheotomy, in hospital practice intubation. But every effort should be made to avoid operation, because when the rash comes out the laryngeal distress usually subsides.

If **Bronchitis or Lobular Pneumonia** should set in, it must be treated on the usual principles. But in measles the following measures will be found useful. Rub the skin of the chest with compound camphor liniment once or twice a day, put on a light cotton-wool jacket next to the skin; keep the air round the patient moist as in laryngitis, adding oil of eucalyptus, 5 to 10 min. to a pint, or compound tincture of benzoin, a drachm to a pint, to the water in the kettle. In the early stage of the pulmonary complication the following mixture will be found useful: Ammon. Carb., gr. 3; Vin. Ipecac., ♏5; Tinct. Camph. Co., ♏15; Syr. Tolu., ♏30; Aq., ad ℥j [U.S.P. ℞. Ammon. Carb., gr. 3; Vin. Ipecac., ♏3; Tinct. Opic. Camph., ♏15; Syr. Tolu., ♏30; Aq., ad ℥j]. Dose, 1 to 4 drachms (according to age), every four hours.

Later, when the cough is loosening and the secretion from the bronchial tubes is more copious, the compound tincture of camphor and the syrup of tolu should be omitted, and tincture of squill, 10 to 15 min. [U.S.P. 5 to 8 min.], substituted. In serious cases brandy in doses of 10 to 30 min. every three or four hours is beneficial.

Dr. Claude Ker, of the City Hospital, Edinburgh, advocates the treatment of cases of lobular pneumonia in the open-air during the day, and states that this method gives excellent results. He writes thus: "I am now content to depend upon open-air and suitable diet for the treatment of these cases, and, beyond seeing that the chest is adequately protected, seldom order anything further."[1]

For **Lobar Pneumonia**, fortunately not common in measles, linseed-meal poultices should be applied to the affected area in the early stage, when pain is often present. When the pain has ceased a cotton-wool jacket should be substituted. When the temperature is persistently high and there is delirium, an ice poultice should be applied instead of one of linseed-meal. Stimulants are usually required in severe cases. In both forms of pneumonia, if there is cyanosis, the patient should be made to inhale oxygen at frequent intervals.

Eyes.—In most cases there is slight conjunctivitis, and it is essential that the eyelids should be kept clean. They must be bathed frequently with warm boracic lotion. Should the inflammation increase the conjunctivæ must be painted once a day with a solution of silver nitrate, 5 to 10 gr. to an ounce. This treatment suffices in the majority of cases. For severe and intractable cases the reader is referred to the article on conjunctivitis. If the cornea becomes inflamed the pupils should be kept dilated with atropine, lest haply the inflammation spread to deeper structures. In ulcer of the cornea the yellow oxide of mercury ointment is the best application. The eyes should be kept shaded.

For **Otorrhœa** gentle syringing of the ear two or three times a day with boracic lotion or peroxide of hydrogen is usually sufficient. If further trouble arises it must be met according to ordinary surgical principles.

Diarrhœa is often troublesome about the time the rash is fading or soon after. Attention should be paid to the diet, as has been advised for the same symptoms in the earlier stages. Mild symptoms will usually yield to intestinal astringents. When the symptoms lead to the conclusion that the large intestine is inflamed, the bowel should be washed out twice a day with copious injections of warm water or normal saline solution. If these measures fail, small doses of laudanum should be given either by mouth or in starch enemata. Some cases, especially those in which the stools are very offensive, do best under treatment by intestinal antiseptics, such as resorcin, carbolic acid, acetozone, perchloride of mercury, or salol.

Convulsions are best treated with hot baths and bromide of potassium and chloral hydrate.

The **Glands**, especially of the neck, occasionally become inflamed; they should be painted with glycerine and belladonna and kept covered with cotton-wool. This treatment appears often to avert suppuration.

Stomatitis is frequent in measles; ulcers appear on the buccal mucous membrane and tongue, whence they may spread with great rapidity to the palate, pharynx, and even to the larynx. When once this ulceration has begun to spread, it is most difficult to arrest its progress. The patient may die of secondary lung infection or from toxæmia. Therefore, from the commencement of an attack of measles, care must be taken to keep the mouth clean.

Useful preparations for this purpose are: Glycerine of borax, 1 oz.; tincture of myrrh, 2 drachms; water to 12 oz.; and Borax, 1 drachm; bicarbonate of soda, 1 drachm; common salt, ½ drachm; chlorate of potash, ½ drachm; compound tincture of lavender, 1 drachm; water to one pint. The nurse must be directed to swab the mouth with pledgets of wool soaked in one of these solutions and to pay particular attention to the gums and teeth.

Cancrum Oris, a very fatal complication, is occasionally met with. An effort should be made to stop its spreading by the application of pure carbolic acid. This complication sometimes supervenes upon stomatitis. Stomatitis is communicable from one child to another; so that precautions must be taken to prevent its transmission, at the very least by reserving for his special and sole use all the utensils and other articles that are necessary for the patient.

Late Laryngitis, occuring after the rash has come out, is not infrequently due to diphtheria; therefore 4,000 units of antitoxic serum should be injected subcutaneously immediately upon its supervention.

Marasmus is a not uncommon sequel of an attack of measles, especially when there has been profuse diarrhœa. Latent tuberculosis is to be suspected, particularly if there is pyrexia. But by no means all the cases are due to tubercle, for the patients usually recover under careful dietetic treatment. Virol, cream, cod-liver oil, Mellin's or Benger's food, and raw meat juice, are all useful. The writer has not had the opportunity of trying the treatment by injection of sea water, recommended by Dr. Robert-Simon for cases of wasting in children due to other causes.

During **convalescence** after severe attacks or when there has been some complication, tonics, such as Parrish's food and Easton's syrup, should be given.

The patient who is convalescent from an uncomplicated attack of measles may be considered to be free from infection at the end of three weeks from the onset of his illness.

E. W. GOODALL.

Reference.

[1] Ker, C. B., "Infectious Diseases; a Practical Text-book," 1909, p. 53.

MENINGITIS.

Tuberculous Meningitis.
Purulent Meningitis, including Meningococcus, Pneumococcus and Streptococcus, and other forms of Meningitis.
Chronic Basilar Meningitis.

TUBERCULOUS MENINGITIS.

In the great majority of cases tuberculous meningitis is part of a general miliary tuberculosis ; as such it must be regarded as an incurable disease by all the therapeutic measures at present available. The question is one of diagnosis : if the patient is suffering from meningitis, and the nature of the infection is B. Tuberculosis, the prognosis is well nigh hopeless. If no proof exists that the infecting agent is the tubercle bacillus, then, however suggestive of this cause the symptom-complex may be, there is always hope that the suggestion may not be verified, and that, therefore, recovery is possible. Again, if no proof exists that meningitis is present, although the patient is known to suffer from a tuberculous lesion in or about the central nervous system, there is hope that the lesion is local, and, therefore, capable of arrest. Assuming the diagnosis to be placed beyond doubt, especially by the results of lumbar puncture, the treatment should be carried out on the following lines :

(1) **Non-specific Measures.**—The patient is, of course, confined to bed. The head is shaved and an ice-bag is applied, or Leiter's tubes are used. These measures often relieve headache and the restlessness of the early stage of the disease. The diet consists of fluids, but on account of the obstinate constipation which is often so marked a feature, milk is only given in small quantities. The bowels are induced to act by means of pulv. jalapæ co. or by pil. calomel et colocynth. co., assisted by glycerin suppositories. In the late stage of the disease nasal feeding may be necessary, on account of drowsiness or coma, and the constipation may require a drop or two of croton oil by mouth. For the headache and delirium of the first seven to ten days of the disease the best remedy is a mixture of potassium bromide and chloral, which it may be necessary to repeat at fairly frequent intervals. In some cases an occasional hypodermic injection of morphia is necessary when this mixture fails. The

urine may need removal by catheter. Some authorities recommend the exhibition of iodide of potassium, or of mercury, to assist the absorption of inflammatory exudate : there is no reason why both should not be given, and in full doses.

(2) **Specific Measures.**—Both anti-tuberculous serum and tuberculous vaccine (*i.e.*, tuberculin) have been extensively employed in this disease, but without any good results. Now and again reputed successful cases are recorded, but the complete diagnosis, as defined at the outset of this article, is usually lacking in these instances. However, the disease is of so desperate a nature that the employment of tuberculin is to be encouraged, if only to test the effect of this remedy upon the course run by the malady. The course of most cases of tuberculous meningitis, at least in children, in whom it is much more common than in adults, is about three weeks—quite often it is three weeks to a day. If it were shown that cases treated by tuberculin ran a longer course than this with considerable frequency, this would be great encouragement to proceed with the remedy, and to employ various methods of dosage. The great difficulty at present appears to be the short time allowed by the disease in which to establish the response to this specific stimulus.

(3) **Drainage.**—The lumbar puncture which has been undertaken for purposes of diagnosis may well be repeated at intervals of three or four days during the course of the disease, with the object of removing toxic products and bacilli.

T. J. HORDER.

PURULENT MENINGITIS.

It is customary to include all forms of acute meningitis which are not tuberculous in origin under this term. It must, however, be borne in mind that the nature of the infection is very different in different cases, and that the tendency to suppuration varies with the nature of the infection and with the course of the disease.

The treatment of this condition involves three considerations : (1) The question of the specific treatment of the infective process ; (2) the question of drainage ; (3) and the question of palliative measures.

THE SPECIFIC TREATMENT OF THE INFECTIVE PROCESS.

The knowledge that acute meningitis is the result of microbic infection of the pia-arachnoid and of the superficial grey matter of the brain (meningo-encephalitis) leads naturally to a desire to combat the infective element in any case in which the nature of the infection is known and admits of such treatment. Such efforts as have been made in this direction are fairly encouraging. They are incorporated in the following suggestions for the specific treatment of special groups of cases. They should never, however, be allowed to displace other points in the treatment, especially those considered under the next heading. Indeed, it is possible that much of the good thought to result from the use of anti-sera in the treatment of meningitis may really be due to the free removal of cerebro-spinal fluid prior to the intra-spinal injection of the serum. In the following paragraphs it is taken for granted that a differential bacteriological diagnosis has already been made by means of lumbar puncture.

(1) **Meningococcus Meningitis** (cerebro-spinal meningitis; cerebro-spinal fever; post-basic meningitis; cervical opisthotonus of infants).—The serum should be injected intra-spinally, after the removal of a certain amount of cerebro-spinal fluid by means of a lumbar puncture. In a severe case it is advisable to remove as much as 40 cubic centimètres of cerebro-spinal fluid in an adult, and as much as 20 cubic centimètres in a child; and to inject the same amount of serum very slowly, the needle or cannula having been allowed to remain *in situ* after the lumbar puncture. The serum to be injected is warmed to a temperature of 98·4° F. before use. During the injection the patient lies with head low and hips high, and remains in this position for a couple of hours afterwards. This treatment may be repeated on consecutive or on alternate days, or at less frequent intervals, and the dose of serum may be varied in amount according to the course of the disease and its severity.

(2) **Pneumococcus Meningitis.**—This form of infection is too often fulminating in character, allowing little time for therapeutic procedures. But as soon as the diagnosis is made it is advisable to give the patient the benefit of an intra-spinal injection of anti-pneumococcus serum. If the course of the disease is not rapidly fatal, but the patient appears to respond to treatment, assisted by drainage, very small doses of autogenous vaccine should be given, such as from one to five million killed pneumococci, at intervals to be decided by the clinical features of the case. At the same time the use of the anti-serum may be continued.

(3) **Streptococcus Meningitis.**—This infection is commonly associated with primary disease of the ear, nose, sinuses, etc.

When diagnosed the same procedures should be adopted as outlined for pneumococcus infection of the meninges. As a rule the course of the disease is less rapid, and more time is available for treatment, although the mortality is a good deal higher than in meningococcus infection. Considerations of drainage are particularly important in streptococcus cases.

(4) **Other Forms of Infection.**—A number of other micro-organisms cause purulent meningitis, but no rules can be laid down for the treatment of the cases; each must be considered on its merits at the present stage of specific therapy. None is nearly so common as either of those just dealt with. *Staphylococcus infections* are not often met with apart from streptococcus infections; they should be met by careful vaccine treatment. Infections by *B. influenzæ* may be treated on similar lines, but in the experience of the writer the results are not encouraging. On the other hand, the writer has seen one very good result from the treatment of a case of meningitis due to *B. typhosus* by small doses of vaccine (ten million), repeated after three days' interval over a period of fifteen days.

THE QUESTION OF DRAINAGE OF THE MENINGES.

(1) **Drainage by Lumbar Puncture.**—The spinal theca is usually punctured between the third and fourth or between the fourth and fifth lumbar vertebræ. The surface marking for the spine of the fourth lumbar vertebra is a horizontal line joining the highest points of the crests of the iliac bones. The vertebral spine lying nearest to this line is that of the fourth lumbar. The point of puncture is therefore chosen midway between this spine and the spine immediately above or below it. In infants the mesial line is chosen, in adults a point lying about ½ inch to one side of the mesial line, thus avoiding the stout ligaments lying in the mesial line. For the puncture a stout needle is chosen, having an accurately fitting stylet in it at the moment of puncture. Or a well-sharpened trocar and cannula may be used. In the case of an adult the instrument should be at least 4 inches long. It must be boiled immediately before use. The skin at the site of puncture is well washed with soap and water, and is then treated by alcohol, or ether, or acetone. The question of an anæsthetic must be considered. In very young children who can be held in position an anæsthetic is not necessary; nor in adults who are capable of understanding what is being done; nor, of course, in comatose patients. But in all others it is advisable to give a

general anæsthetic. The position of the patient is important: the spine should be arched with convexity backwards, and should be as straight as possible. The thighs should be well flexed. The direction of the puncture is straight forwards in the case of an infant, and forwards, with slight obliquity inwards and upwards, in the case of an adult. The needle is pushed boldly on until the feeling is that of its having entered the canal. If bone is encountered before this happens, the needle is withdrawn very slightly and the direction is altered a little. When the position of the needle seems satisfactory the stylet is withdrawn. In all cases fluid should flow if the needle is in the canal. If no fluid flows, the most likely cause is that the needle has not entered the canal. Much less frequent causes are that the entrance of the needle is blocked by a nerve root, or that the exudate is too inspissated to pass. The needle must in any case be withdrawn, and a fresh puncture made, choosing, for preference, another spot.

No rule can be laid down to govern *the amount of fluid* which it is advisable to draw off, nor for the frequency with which it is advisable to repeat the puncture. These points must be determined in each case by the effects observed after the drainage and by the course of the disease. It is sometimes a good thing to leave the needle or cannula *in situ* for an hour or two, or even longer. In one very severe case of meningococcus meningitis in a young adult, with coma and great emaciation, after repeated punctures the writer allowed a cannula to remain in position all night. During this period more than 300 cubic centimètres of highly turbid fluid drained away. The patient ultimately made an excellent recovery.

(2) **Direct Drainage from Cerebral Meninges.**—In cases of purulent meningitis which are secondary to local infections (ear, nose, etc.), it is probably of greater benefit to drain the meninges at or near to the focus of infection than at a place remote from it. When a radical operation has been undertaken for middle-ear disease or for mastoiditis, and meningitis appears as a complication, it is comparatively easy to expose the dura mater (it may already have been exposed during the operation), incise it freely, and insert a tube into the pia-arachnoid. This would certainly seem to offer the best chance of recovery in this desperate condition. When meningitis occurs as a primary condition it is doubtful whether such a procedure should be attempted, even when drainage by lumbar puncture, together with whatever other remedies are being used, seems to fail to check the course of the disease.

Unfortunately the site of collection of the pus, or the greater part of it, is often in the basic or post-basic region, positions well nigh inaccessible to surgery. If, however, the symptoms point clearly to a collection of pus at some part of the convexity of the brain, the question of direct drainage should be considered.

PALLIATIVE MEASURES AND GENERAL POINTS IN TREATMENT.

The patient should be confined to bed. In all cases where the course of the disease is longer than a week it is advisable to use a water-bed, because the disease is apt to lead to extreme and progressive wasting, often amounting to emaciation. Bed-sores are, therefore, to be anticipated, but should be prevented, if possible, by careful attention to the skin. If they arise they are to be treated on the lines indicated in the article on the Management of the Sick Room. The diet is determined by the acuteness or otherwise of the disease-process: it should be as liberal as possible. Care must be taken to avoid entrance of food particles into the trachea whenever swallowing is difficult, and in any case of doubt resort should be had to nasal feeding too early, rather than too late.

It is doubtful if drugs have much influence upon the disease-process. Mercury and iodides may, however, be exhibited, as they may perhaps assist in the absorption of the inflammatory exudate. Bromides may be given for restlessness and insomnia, and their effect should be enhanced by the use of chloral if delirium is troublesome. Headache and delirium are both influenced beneficially by completely shaving the head and by applying Leiter's tubes or an ice-bag. The constipation which is a common feature of the disease is best treated by enemata, supplemented by very small doses of croton oil in the case of comatose patients.

T. J. HORDER.

CHRONIC BASILAR MENINGITIS.

This is a specific disease, caused by a special micro-organism, and is characterised by an acute stage with fever, vomiting and convulsions, followed by a more or less prolonged illness with signs of increased intra-cranial pressure. The organism causes an inflammation of the meninges at the base of the brain, and in consequence of this the foramen of Majendie is often blocked, leading to a chronic hydrocephalus. During the second period of the disease there is usually head retraction, some vomiting, coma and very often loss of sight. Death may take place early in the acute stage, but may also occur from marasmus several months after the onset. Recovery is not infrequent, a gradual improvement setting in when the disease has lasted two to three months; but some mental impairment is generally left, and the recovery of sight may be incomplete. The disease has considerable resemblance to epidemic cerebrospinal meningitis, and the organism discovered by Still is very like Weichselsbaum's meningococcus. There are, however, slight cultural differences in the two organisms, and they behave differently with regard to agglutination and opsonic indices. The results of treatment confirm the view that the two diseases are not identical.

Flexner and others have rendered animals immune to the meningococcus, and the serum of such animals has been used with conspicuous success in the treatment of cerebrospinal meningitis. The serum is not anti-toxic, but is bactericidal, and must be introduced directly into the spinal theca by lumbar puncture as early as possible in the disease. Flexner's serum seems, however, to have no influence on chronic basilar meningitis. More recently a serum has been prepared at the Lister Institute with Still's organism, and the results of treatment with this new serum have been much more promising. Lumbar puncture should be performed as early as possible in the disease, and a bacteriological and cytological examination made of the fluid withdrawn. If Still's diplococcus is found, no time should be lost before again withdrawing 10 to 20 cubic centimètres of cerebrospinal fluid, and injecting slowly an equal quantity of the serum; during the injection the hips may be raised, so that the serum may flow to the upper part of the spinal canal where the disease is situated. This treatment with a special serum is only likely to be of avail during the early acute stage of the disease, when the organism can still be found in the fluid obtained by lumbar puncture. Later the symptoms are a result of the adhesive meningitis having closed the foramen of Majendie, and no good can be expected from any serum. Throughout the course of the complaint many of the symptoms are due to increased intra-cranial pressure, and this may be diminished temporarily by withdrawing fluid by lumbar puncture. The withdrawal may be made daily as long as the fluid flows under increased pressure, and in many cases the symptoms may be much relieved in this way, while it is possible that in some few cases the proceeding may help in preserving life or in lessening the subsequent mental impairment.

During the chronic stage the patients waste very markedly, and the important indications for treatment are to maintain life by careful nursing and feeding, and for a time it may be necessary to feed by a nasal tube. As the child gets better the food is taken more eagerly, and the nutrition rapidly improves. The return of intelligence is very slow, and much patience is required in teaching the infant to walk, talk, and gain control over its limbs.

ALFRED M. GOSSAGE.

MUMPS.

Mumps is one of the most disagreeable of the acute infectious disorders. The pain due to the actual inflammatory swelling, the mechanical impediment to the movements of the jaw, and the pain on deglutition, together make up an *ensemble* of symptoms which in themselves cause sufficient discomfort, but when added to them the patient has high fever, great thirst with inability to quench it, and sometimes deafness, the last straw seems added to the load which the sufferer is asked to bear. For what must be called a minor ailment no more distressing symptoms can be heaped up together, and against them up till now the resources of medicine are practically powerless. We have to deal with an acute inflammatory condition in the parotids which spreads to the lymphatic glands, is due to an unknown germ, and for which we have no specific. The glands are very large, hard and tender, and local treatment undoubtedly gives some relief. The usual method of applying it is by means of hot poultices or fomentations, which are copiously sprinkled with tincture of opium. Hot dry heat, either by means of flannels or sand-bags, is used by some, and has certain advantages. It is not so messy, and seems not to be so cold to the patient's skin when the application cools to the temperature of the body. But whether the dry or wet method is employed it is essential that the applications be changed frequently, not less often than once every hour, and if possible oftener. For internal administration, as we have no specific, we must be contented with such medicines as will act upon the skin and cause diaphoresis, and such as will allay the pain. For those who are old enough to take it the following mixture will be found to meet both of these desiderata: ℞. Liq. Ammon. Acet., ℥jss; Liq. Opii Sedativ., ♏36; Pot. Nitrat., ʒij; Aq., ad ℥vj. *Sig.:* $\frac{1}{12}$ part every four hours.

If the patient is unable to swallow, or can only swallow in very small quantities, it is on the whole admissible not to force the medicine but to administer morphine in doses of $\frac{1}{20}$ to $\frac{1}{6}$ gr. subcutaneously or in a suppository per rectum, the dose of opiate in each case being regulated by the age of the patient. In these severe cases the patient is practically unable to swallow nourishment, and the physician has to be content with allowing him to follow his own devices. Sips of cold water are most gratifying to the fevered tongue, and ice may be allowed if the patient desires it, as there is no fear of his taking such quantities as to hurt him. Anything further must be a clear soup or beef-tea, or some milk, or milk and water or soda-water. Junket or other semi-solid of that nature, like jelly, will sometimes slip down, when swallowing liquids requires a painful effort.

This condition may last for some three or four days or even longer, and then abate and the patient rapidly convalesce. Fortunately most cases of mumps, even of severe type, are not quite so terrible as that pictured above. Infection generally attacks first one parotid and then the other, and it frequently happens that the second one is not attacked until the first one is at its acme, and that therefore the acute signs are abating in the latter while they are increasing in the former. This allows the patient some respite not from pain, but from the dysphagia, and therefore permits him to swallow both medicine and nourishment. The latter will be the usual liquid nourishment of acute illness, milk, beef-tea, jellies or light milk puddings. Tea or coffee should not be forbidden.

Complications.—Suppuration sometimes occurs in mumps, and when pus is found to be present the sooner an incision is made into the abscess the better. The commonest complication of mumps is orchitis, the treatment for which will be found under that heading.

H. A. DES VŒUX.

PNEUMONIA.

Directly it is suspected or discovered that a patient is suffering from pneumonia he must be put to bed and must stay there till some days after his temperature has become normal. The bed should be narrow, a double bed makes nursing and medical examination difficult. A feather bed is particularly objectionable. The bed clothes should be light. The room should be well ventilated. A large room with open windows and, if necessary, a fire is best. It is not uncommon to find the sick room stuffy; this is both disagreeable and harmful to the patient. The temperature of the room should be about 60° F., but a little below this is better than raising the temperature by making the air stuffy. The motions must be passed into a bed-pan and the urine into a bed-urinal. The length of the stay in bed must depend upon the severity of the disease, but if it has been of average severity and without complications the patient may get up for the first time when the temperature has been normal for a week. Milk is the best food; an adult may take 2½ or 3 pints a day, given in hourly feeds when he is awake. The advantage of milk is that it is fluid and the patient is thirsty, it is easy to digest and it is pleasant for the dry mouth. Should sickness or the passage of curds in the motions show that it is not digested, it may be peptonised or sodium citrate may be added. Two grains should be dissolved in a little water and added to each ounce of milk. If the appetite and digestion are good an egg may be beaten up with one of the pints of milk. Some patients much dislike the taste of milk. A little black coffee or essence of vanilla or essence of cinnamon added to it will overcome this. Very often beef-tea, meat extracts, chicken broth and other preparations of the extractives of meat are given, but certainly often unnecessarily. At any rate, the mainstay should be milk, unless there is a great repugnance to it. Sufferers from pneumonia are usually thirsty; Imperial drink generally relieves their thirst. It consists of acid potassium tartrate, 60 gr.; saccharin, 1 gr.; oil of lemon, 3 min., to a pint of barley water and allowed to cool. A sweet succulent orange is sometimes relished. The mouth and tongue are often very dry and foul and must be kept clean. If the patient is strong enough he should rinse his mouth out several times a day with an antiseptic gargle; 1 in 500 solution of formalin or 15 min. of glycerinum acidi carbolici to 1 fluid ounce of water, are both excellent antiseptic mouth washes. Either may be flavoured with a little tincture of myrrh or eau de Cologne. If he cannot rinse his mouth, the nurse should carefully mop it out several times a day with either of the above gargles, double strength, by means of lint tied on the end of a stick.

The bowels should be well open every other day. Usually an aperient is necessary. It matters little which is given; compound liquorice powder, senna tea, cascara, calomel, colocynth and hyoscyamus are all useful; sometimes a soap and water enema is necessary. In most cases it is better not to apply any local application to the chest for the bandages impair the breathing, but if the patient complains of pain either a linseed or an ice poultice will often relieve it. Some patients prefer one, some the other, and it is quite impossible to tell which will best suit any particular case. If the patient is very hot and feverish an ice poultice should be chosen. To make an ice poultice, put on a piece of gutta-percha tissue a layer of wood-wool, then one of powdered ice sprinkled with a little salt; turn over the edge of the gutta-percha which has been left wide enough, so as to cover in the poultice, and seal the edges with a little chloroform or turpentine. Put the poultice in a flannel bag and bind it on the body where desired with lint between it and the skin.

There is no specific for pneumonia, and many sufferers from it require no drugs except perhaps an aperient. Those which go by the name of **expectorants** are unnecessary and usually do more harm than good, for most of them are nauseating and interfere with digestion and some are cardiac depressants. Many patients suffering from pneumonia do not **sleep** well. Usually 10 or 15 gr. of Dover's powder in the evening gives a good night and relieves the pain in the chest and the troublesome cough if either is present. The benefit that follows this simple remedy is often very great. As pneumonia is a disease of the lungs it has been said that opium, being a respiratory depressant, should not be given. This is a great mistake if it prevents the use of an opiate, such as Dover's powder, at night. Few of those who have pneumonia are livid and danger rarely threatens from respiratory failure, but it frequently threatens from cardiac failure, and opium by keeping the patient quiet is therefore of service. Sometimes, and especially in the case of drunkards, sleeplessness is a great trouble; 30 or 40 gr. of chloralamide dissolved in a little brandy may relieve this, or sulphonal or trional (10 or 15 gr. of either), or 20 gr. of bromide of potassium may be tried. Veronal should not be used, as unexpected cases of poisoning have happened from its use. Two drachms of paraldehyde, flavoured with tincture and syrup of orange and well shaken up in 3 oz. of water, sometimes succeeds, and is especially likely to do so if the sleeplessness is associated with wandering of the mind or with delirium. Should all these fail, $\frac{1}{100}$ gr. of hyoscine injected subcutaneously will often succeed, especially if the patient is delirious. It must be used carefully as it is a powerful poison. If the temperature is very high, cold sponging may help to bring sleep. In some instances a stiff glass of brandy and water at night succeeds excellently, but unfortunately it often fails, indeed, it may increase the wakefulness.

Alcohol, especially brandy, was formerly given in large quantities for pneumonia. I have often seen ½ or ¾ pint, or even more, given in the twenty-four hours, but it is given very much less nowadays. Some patients certainly appear to be the better for some alcohol; they feel better, eat better, sleep better, and have a better pulse, but unfortunately, as with some other drugs, it is impossible to tell beforehand which cases are likely to be benefited. There can often be no harm whatever in trying it, and if the patient is no better for it the use of it can be at once discontinued. It has the advantage of being a food which does not require digestion.

Heart failure.—A fatal issue in a case of pneumonia is usually due to the heart becoming weaker and rapid. Hence if there is any evidence of this digitalis should be given. The following is a useful prescription: Tinct. Digitalis, ♏15; Liquor. Strychninæ, ♏5; Caffein., gr. 5; Sodii Salicylatis, gr. 2½; Aquam Chloroformi, ℥j. [U.S.P. Tincturæ Digitalis, ♏15; Strychninæ Hydrochloridi, gr. $\frac{1}{22}$; Caffeinæ, gr. 5; Sodii Salicylatis, gr. 2½; Aquæ Chloroformi, ℥ss; Aquam, ad ℥j]. The object of the sodium salicylate is to ensure the solution of the caffeine. Such a mixture may be given every four hours to an adult. Digitalis may be given subcutaneously. Tabloids containing $\frac{1}{100}$ gr. of the amorphous variety are sold, and so are tabloids containing $\frac{1}{130}$ gr. of the crystalline digitalin; both are for subcutaneous injection. The crystalline is official in the French Codex and is said to be more powerful than the amorphous. Both are potent drugs and the effect must be carefully watched. Strychnine appears to be particularly useful in severe cases of pneumonia, probably because it acts not only on the heart but also because it is a powerful respiratory stimulant. It has been difficult to avoid the belief that the free use of strychnine has brought about recovery in some cases of pneumonia that I have seen. Five minims [U.S.P. gr. $\frac{1}{22}$ Strychninæ Hydrochlor.], or even a little more, of the liquor may be injected subcutaneously every two or three hours and the effect carefully watched, for of course its use must be stopped if it produces even slight twitchings, but I have often given it in very severe cases up to the point of causing slight twitchings and with apparent benefit. The active principle of the medulla of the suprarenal gland, known as epinephrine, adrenalin or hemisine, powerfully constricts the smaller arteries and so raises the blood pressure, and therefore when the circulation is failing it may be used for pneumonia. The solution usually sold is 1 in 1,000. Ten minims may be injected subcutaneously every one or two hours, especial care being taken not to wound a vein. Larger doses must not be used on account of the early increase in the rate of the heart produced by it. Certainly it often raises the blood pressure and improves the circulation of sufferers from pneumonia, but often it fails when given in doses it is safe to use, and even when it succeeds the effects soon pass off. If used subcutaneously the "vaporoles," each containing 1 c.c. of hemisine, are useful. It is probably useless when given by the mouth, for it is not absorbed from the gastro-intestinal tract. Pituitary extract is a better drug in cases of pneumonia. It is made from the infundibular portion of the gland; it slows and strengthens the heart and causes a sustained rise of the blood pressure. It certainly, as far as my experience goes, is useful when it appears that a patient suffering from pneumonia is in danger of dying from circulatory failure. Vaporoles, each containing 1 c.c. of the extract and corresponding to 0·2 gramme of the posterior part of the pituitary body, are sold and the contents of one may be given subcutaneously to an adult. The pulse will often improve in a few minutes.

The **inhalation of oxygen** gives great relief to many sufferers from pneumonia, even if they are not livid, but it gives still more relief to those who are livid. As a rule, too little oxygen is given; it may be allowed to flow continuously from a funnel pinned to the bed clothes so that the stream of gas comes towards the patient's face, the tap of the cylinder being turned on in such a way as to give a gentle flow. Occasionally a patient dislikes it; often this is because the gas is cold; therefore it should always be passed through a coil of rubber tubing lying in hot water. If the dryness of it is disagreeable, it may be passed through a Wolffe's bottle containing hot water, and some, if the patient is collapsed, make the oxygen bubble through a little absolute alcohol and then let it pass through a rubber tube lying in warm water. I think I have seen this do good. Some are sceptical as to the advantages of oxygen, but, on the other hand, an intelligent man told me once that the inhalation of oxygen made him feel so much better, it was like taking a glass of champagne.

A few patients become livid; then they are much better for being bled. As a rule, about 10 oz. may be taken from the arm.

Fever.—Patients suffering from pneumonia do best when their temperature is between 103° F. and 104° F. If it is much above this, they are often considerably improved by cold sponging. The energy and frequency with which this is carried out depends upon the ease with which the temperature falls, for it is not, as a rule, advisable to reduce it lower than 103° F. The beneficial effect of this treatment is greatest when the high temperature is associated with delirium and a dry mouth. Occasionally, when the temperature exceeds 105° F., and death threatens from hyperpyrexia, a cold bath may be needed, but this is very rarely the case in pneumonia. It may be given in just the same way as for typhoid fever (*q.v.*), but the patient should be taken out of the bath directly his rectal temperature has reached 103° F.

In a few cases a low temperature in pneumonia, viz., about 100° F., means that the patient has a very mild infection, but in the majority of cases it means that he is severely ill, because he is not reacting to the infection. Then he should be kept warm, have a hot-water bottle in his bed, and by means of big fires the temperature of the room should be maintained at between 65° and 70° F.

It has already been pointed out that patients with pneumonia are more often in danger from failure of the circulation than from failure of the respiration. Incidentally, the best means at our disposal for stimulating the respiratory centre has been mentioned, namely, strychnine; when the temperature is very high, the application of cold benefits not only by the reduction of it but by stimulating the respiratory and cardiac mechanisms. When the respiratory difficulty is associated with lividity it is lessened by bleeding. Expectorants, it must be remembered, are useless and even harmful, but some think very highly of the subcutaneous injection of atropine; it is a powerful respiratory stimulant, and if there is much secretion it helps to dry this up. Unfortunately, the dryness of the mouth produced by atropine makes it very disagreeable to some patients with pneumonia, for their mouth is already dry.

Serum Treatment.—Thirteen years ago Washbourn and Payne immunised horses, donkeys and goats against pneumonia, and the serum from these animals was used just as antidiphtheritic serum was used for diphtheria. At the time I saw several of the cases treated with it, but could not convince myself that they were benefited; the opinion of others who tried it was the same, and as theoretical reasons were against the likelihood of its success it was not extensively tried. The reasons why success was not likely are, the serum is not anti-toxic but anti-bacterial only, and by the time that the diagnosis is made the infecting organisms must be so numerous that a purely anti-bacterial serum is of little use. Further, unfortunately, the chief dangerous symptoms of pneumonia are certainly toxic, so that what is really wanted is a powerfully anti-toxic serum. Lastly, strains of pneumococci vary in many particulars, and it has been found that a serum which is anti-bacterial to some strains is not to others, and it is obviously impossible to prepare a serum from the patient's own pneumococci, for the preparation of a serum takes many weeks.

Vaccine Treatment.—This has not been nearly so extensively used for pneumonia as for some other diseases. Here, again, a great difficulty is the varying character of the strains of pneumococci. Those from one patient may be different from those from another. Often a patient with pneumonia is not seen in the hospital till the third day of the illness, so that as the crisis often occurs on the sixth day, there is no time to prepare a vaccine and give it at such a period that we can be sure that an improvement is due to it, and as the strains of pneumococci vary so widely, it is of little use to give a vaccine unless it is prepared from the patient's own pneumococci (*see* Vaccine Therapy, Vol. III.).

W. HALE WHITE.

RABIES.

(HYDROPHOBIA).

Rabies is an infective disease, man being infected from one of the lower animals. Dogs are the usual channels of infection, but the disease may be acquired from the bite of a cat, horse, cow or wolf. The poison is introduced through the medium of the saliva. Infection of the central nervous system takes place by way of a peripheral nerve.

Treatment at Sight.—The wound must be thoroughly cauterized *at once* with the actual or thermo-cautery. This is of fundamental importance, for by such treatment the incubation period will certainly be lengthened and the chance of the patient's recovery materially increased. Antiseptics are of little value so far as regards destruction of the virus, though it is absolutely essential that the utmost care be exercised in keeping the wounds clean and free from pyogenic infection.

The Incubation Period is very variable, but usually occupies from two to eight weeks. It depends in all probability on the site of inoculation, the character of the bite, and what period has elapsed from the time of the bite until the application of the actual cautery to the wound. The duration of the acute illness is usually about four to ten days, and unless early treatment is adopted death invariably results.

Pasteur's Inoculation Method of Treatment.—This is now universally adopted, and it is to be regretted that it cannot yet be obtained in this country. By its use the ordinary mortality among all persons bitten has been reduced from 16 per cent. to less than ·5 per cent. amongst those individuals bitten by " verified " animals. The method of treatment is based on Pasteur's fundamental discovery that the spinal cords of rabbits dead of rabies contain the potent virus, and that emulsions prepared from segments of these cords which have been dried in air for varying periods of time possess such different degrees of virulence that the activity of the virus can be so attenuated as entirely to disappear. Thus, it was found that if a rabid cord were dried for fifteen days in air, and emulsions prepared from it, these were entirely innocuous. Pasteur further demonstrated the fact that by passage through a series of rabbits the virulence of the virus could be considerably exalted. On these data he built up his immunisation treatment, which consists in giving a daily subcutaneous injection of a saline emulsion of segments of attenuated cords, the first dose being derived from a segment of cord dried for fourteen days, followed on the next day by an injection from a cord dried for twelve days, and again on succeeding days by injections from cords dried for eleven, nine, eight days and so forth, finally completing the immunisation process by employing an emulsion prepared from a segment of virulent cord which has only been subjected to the drying process for one day. The entire period of treatment occupies about a fortnight.

This method has proved eminently successful, but it has undergone slight modifications in recent years, primarily for the benefit of those patients who have been severely bitten (*e.g.*, by wolves) and for those cases which have come under treatment at a late stage. This modification is known as the "Intensive System," and is carried out by giving injections on the first day at six hourly intervals, of emulsions of cords dried for fourteen, thirteen, twelve and eleven days, then on the second day in the same way, doses derived from cords dried for ten, nine, eight, and seven days, and proceeding in this way until a dose from a cord dried for one day is administered. In this manner the immunisation machinery reacts more quickly with proportionately beneficial results.

Numerous other modifications of Pasteur's method have been introduced from time to time. Hogyes, of Buda-Pesth, makes use of emulsions of fully virulent cords, giving extremely small doses. Marie employs a mixture of virus and serum obtained from an immunised animal, whilst in Italy Centanni attenuates the cords by partial gastric digestion. Other methods of academic interest might also be mentioned.

If for any reason the patient has postponed the preventive treatment, it is advisable to inject antirabic serum as a prophylactic measure. This has been employed in Italy by Centanni with some success, and is administered subcutaneously in doses of 10 c.c. at intervals of three days.

When a person has been bitten by a rabid animal under no circumstances should the animal be destroyed offhand. It should be kept under close observation. It is of great importance that the nervous system of the suspected animal, packed in ice or immersed in glycerine, should be sent with the patient to the nearest Pasteur Institute (25, Rue Dutot, Paris) for verification.

HAROLD SPITTA.

RELAPSING FEVERS.

There is a good deal of difference between the severity of the Indian, African, American and European relapsing fevers, and the complications that are common in one form are rare in the others. This is important, as in none, till recently, was there any specific treatment. The observations so far made are in favour of a definite specific action by Ehrlich's 606; and if these are confirmed and extended to other relapsing fevers no doubt this and similar drugs will reduce the dangers of the disease. In the symptomatic treatment it is not only of importance to deal with the complications as they arise but also to anticipate them and if possible prevent them. A patient with relapsing fever must be kept warm in bed not only during the pyrexial period but even in the mildest cases for at least three days after the fever has subsided. If allowed up he must return to bed about the time the recurrence is anticipated.

The period of greatest danger is the crisis, as with the sudden fall of the temperature there is dangerous and often fatal collapse. This collapse is more dangerous if the pyrexial period has been a long one. It is therefore advisable to commence the administration of alcohol on the fifth evening, as if the pyrexial period is more prolonged than this the collapse will be severe. Constipation is the rule during the early part of the febrile attack and should be relieved by saline aperients or enemata. With, and sometimes before, the crisis there is usually diarrhœa, often dysenteric in character. No attempt should be made to check this unless it persists more than twenty-four hours.

Pulmonary complications are most common in the Indian variety and cause many deaths. Great care should be taken to avoid chills and stimulant expectorants should be given freely. If there is dyspnœa oxygen should be given and every attempt made by the use of alcohol and cardiac stimulants, such as strychnine, to keep the patient alive till the crisis and collapse stages are passed, as then there is usually rapid improvement.

The pyrexia is best relieved by tepid sponging; quinine is, in the opinion of the writer, useless, and may incite vomiting and increase the headache. Synthetic antipyretics are dangerous except in the mild cases or during the first two days of an attack.

Vomiting may be a serious symptom. Hot applications, such as turpentine stupes, to the epigastrium, may give relief. Iced drinks may be of service. If these fail, hypodermic injections of morphia ($\frac{1}{8}$ gr.) may succeed. Jaundice, most common in the Indian form, is marked in the severe cases, but requires no treatment; it will rapidly disappear during convalescence.

Iritis and other eye troubles, as well as facial paralysis, are most common in the African form; these should be treated on general principles.

During the pyrexial periods only liquids can be given; but in the apyrexial periods, as soon as the effects of collapse have passed, the patient should be well fed on light but nutritious diet.

Some authorities place a higher value on quinine than the writer does and give it in full doses during the pyrexial period. Others advocate the use of mercury. It is certain that neither of these drugs are specifics, though apparently in Ehrlich's "606" a specific has been discovered.

C. W. DANIELS.

RHEUMATIC FEVER (ACUTE).

This condition appears to be due to an acute bacterial infection, although the precise character of organism has not yet been definitely settled. The evidence of bacterial infection is sufficient, however, to render it necessary for us to treat such cases on the general principles underlying the treatment of all acute infective diseases. In addition, we have certain peculiarities in acute rheumatism, such as the effect of salicylates upon the temperature and the pain, and the effect of diet in determining the probability of a relapse. There has been, and still is, much difference of opinion as to the value of salicylates, and of the method in which they are given: whether they should be combined with alkalies; and again as to the question whether meat or meat extracts render a relapse probable. Twenty years ago I watched the course of a considerable number of acute cases of this infection under the care of Dr. P. W. Latham, which were treated on definite lines at Addenbrooke's Hospital, Cambridge. Since that time I have had numerous opportunities of carrying out this form of treatment, and of comparing its results with those obtained from other forms of treatment. Experience has forced me to the conclusion that the treatment advocated by Dr. P. W. Latham reduces the pain and fever more quickly than the other methods, and that under its use heart complications are decidedly less frequent and relapses uncommon.

In this article I therefore confine myself chiefly to an account of this treatment, but I would emphasise the necessity of observing the precise details as to: (1) The use of *natural* salicylates and the method of their administration; (2) the character of the diet; (3) the careful regulation of the bowels by mercurial preparations; (4) the careful toilet of the mouth. In the great majority of cases this treatment leads to a fall of temperature to the normal and cessation of all pains within twenty-four to thirty-six hours.

The principles of treatment for acute rheumatic fever are the same whether the disease occurs in adult life or in childhood. In the case of children, however, there is a marked tendency for the articular manifestations to be less severe than in adults, or to be represented only by vague pains, and for the heart to be severely affected. The results of treatment in childhood, therefore, depend largely on the early recognition of the cause of the pains and the immediate application of rest. Otherwise there is no essential difference which affects treatment. In both adults and children the chief aim of treatment is to prevent damage to the heart, and this is best procured by the prompt application of rigid rest at the commencement of the disease, together with the immediate administration of natural sodium salicylate in such doses that the particular patient is brought quickly under its influence. It is a difficult thing to explain, but salicylates appear to act differently in different climates. Their use is apparently not nearly so effectual in certain parts of North and South America as in Europe. So much is this the case that in a few hospitals in these countries the use of medicines in this disease is largely discarded, and the treatment adopted is to wash out the affected joints. This treatment at first sight appears heroic, but in practice it is simple and gives good results.

GENERAL MEASURES.

The first essential is absolute *rest in bed*, in order to limit auto-inoculation. The affected joints should, as far as possible, be fixed in a comfortable position until the acute symptoms have passed off. For this reason it is necessary to have the services of well-trained nurses, who are capable of lifting the patient without undue movement on his part. The *room* should be well ventilated and kept at 60° to 65° F. The patient should be protected by screens from any draught. The patient's *clothes* should be loose and capable of absorbing the sweat. For this purpose a "cellular" nightdress is best, although soft flannel is generally used. The nightdress should open down the front from top to bottom. It is an advantage also if it opens along the sleeves. By these means the nurse can readily carry out the necessary process of drying the patient frequently until the condition is under control without disturbing him. The patient should lie between clothes which absorb the perspiration; soft, light blankets are generally used for this purpose. They are certainly more conducive to comfort than sheets. The bedclothes should be light, and their weight should be lifted from the patient by means of a cradle.

Local Applications.—Hot fomentations should be applied to the affected joints, which should be enveloped in cotton-wool and lightly bandaged to a back splint. If the pain is exceptionally severe, an anodyne lotion such as: Extr. Opii Liquidi, ʒij; Liq. Plumbi Subacet., ℥ss; Aq. Destill., ad Oj, may be used in the fomentation. As a rule under efficient treatment the severe pain yields completely to salicylates within forty-eight hours; consequently anodyne fomentations are seldom required for long. The splints may be removed when the temperature has been normal for twenty-four hours; it is wise to continue the use of the wool covering for a day or two longer.

Diet.—The regulation of this is of the utmost importance, as experience has shown conclusively that the early use of meat or meat extracts, such as beef-tea, during the acute stage tend to prevent the temperature being lowered quickly, whilst their use too early during convalescence increases the probability of a relapse. Nothing but milk should be given until the temperature has been normal, or at any rate below 99° F., for twenty-four hours. If milk is not well borne, it should be diluted with barley-water, and 1 to 2 grs. of sodium citrate added to each ounce. Two to four pints may be given during the twenty-four hours. Bread-and-butter and farinaceous food may be added when the temperature has been normal for twenty-four hours. No soup, beef-tea or other meat extract, meat or fish should be permitted until the temperature has been normal for ten days. In the great majority of instances this rule should be rigidly followed. There are, however, instances in which for some cause the evening temperature remains at 99° or 99·5° for some weeks. In such cases fish and lightly cooked fresh meat may be permitted at the end of three weeks from the onset of the disease. In all cases water, barley-water, Vichy water or similar drinks should be freely allowed in small quantities at a time.

Medicinal Measures.—There is some evidence that the causal organism of rheumatic fever enters the body through the tonsils. Further, the presence of diseased and septic teeth may cause the temperature to keep at 99° or slightly over for some time after the rheumatic manifestations have subsided. It is, therefore, important that the *toilet of the mouth* should receive adequate attention. A mouth-wash such as listerine should be used daily, and the tonsils should be swabbed over with 1 in 100 carbolic acid. If the teeth are diseased they should also be thoroughly swabbed over, together with the neighbouring gums, with 1 in 100 carbolic acid. If the temperature remains at 99° or 99·5° F. after the first week after salicylates have been properly given, the bowels kept open if necessary with mercurial preparations, and the use of meat and meat extracts avoided, the presence of diseased teeth may be responsible. The use of a polyvalent streptococcic vaccine should be tried, and if this fails the offending teeth should be removed.

Calomel or Hydrargyrum cum Creta.—It is essential that the bowels should act satisfactorily each day. At the onset of treatment calomel (gr. 5) should be given at night and a saline the following morning. Throughout treatment if the bowels are not opened during the preceding twenty-four hours, or whenever there is any elevation of temperature or increase in pulse-rate, calomel (gr. 3 to 5) or hyd. c̄. creta (gr. 3 to 5) should be given. Neglect of this precaution is not infrequently the direct cause of a relapse.

Salicylates.—There are three essentials in the use of these remedies: (1) The natural salts, although more expensive, should always be used. I have tried all forms of salicylates, natural, artificial and the so-called physiologically pure, and I find that the effect on the temperature and the pain is incomparably greater and more regular when the natural salts or acid are employed. Further, intolerance to the drug and such unpleasant symptoms as vomiting are much less frequent where the natural salts are employed. (2) The dose, and spacing between the doses, should be such that the individual patient is quickly brought under its influence; that is to say, its use should be pushed until slight symptoms of poisoning appear, such as headache and buzzing in the ears. In adults 20 gr. of the natural sodium salicylate in infusion of orange should be given every hour for three doses, or if the head remains unaffected, for four doses. Children are tolerant to this drug, but the dose should naturally be proportionate to the age, *e.g.*, 10 gr. an hour for a child of ten for three, or in many cases four, doses. (3) The patient should be kept under the influence of the salicylate for ten days after all pain and fever have gone. After the first three or four doses the frequency of the doses should be gradually diminished. The dose should be kept after the first four doses at such an amount that it is just insufficient to cause headache or buzzing in the ears. As a rule 80 gr. daily is sufficient, and this amount should be given daily for ten days after all pain and fever have gone. Many authorities lay stress on the use of *alkalies*, giving 15 to 20 gr. of sodium bicarbonate with each dose of salicylates. In my hands this mixture does not give such satisfactory results as the salicylate alone; consequently I have ceased to employ alkalies at all in this condition. (4) The action of the kidneys should be carefully watched. If there is a condition of albuminuria, salicylates should not be given, as their use in such cases has led to total suppression of urine and death. The urine should be tested daily, and if albumin makes its appearance the use of salicylates must be discontinued. After the interval of a day or two aspirin may be tried instead, as this form of salicylate does not appear to have this drawback to its use. In a small number of cases, but less commonly when the natural salicylates are employed, the patient shows an intolerance to the use of the salicylates. In some cases there is wild delirium, in others there is suppression of urine, in others vomiting. Not infrequently such patients will tolerate aspirin in full doses. If aspirin is used, however, as a routine measure in the first instance instead of the natural salicylate, the number of cases which are intolerant to its use is greater than in the case of the latter drug. Other preparations of the salicylates or their derivatives have no advantages, and are, in fact, less efficient in this condition.

Serum Treatment.—So far no satisfactory results have been obtained by the use of any serum prepared for the treatment of rheumatic fever.

COMPLICATIONS.

Persistence of Temperature.—As already stated, the temperature, although much diminished, may remain above the normal for some little time. The diet should consist entirely of milk for some weeks, and the bowels should be well opened by a daily purge of calomel. The teeth may be the cause of the fever, and, if so, should receive attention on the lines already mentioned. If these measures fail to reduce the temperature to the normal, gr. 3 to 5 of potassium iodide thrice daily may be of service.

Restlessness.—This symptom is best met by sponging and the addition of 5 gr. or more of sodium bromide to each dose of the salicylate.

Heart Complications.—Some degree of *myocarditis* is so common that it may be regarded as symptomatic. It is, therefore, dealt with in the treatment of the convalescent period (*see* below). The treatment of *acute endocarditis* in rheumatic fever is the same as that of acute endocarditis in the course of other fevers, and is dealt with in a separate article. The chief essential is rigid rest until compensation has occurred. This requires months in many cases if the patient is not to be crippled for life. Digitalis is not indicated in the majority of instances unless the pulse-rate is tending to become faster. There is a difference of opinion as to whether the use of the usual salicylate preparations should be persisted with after seven to ten days if endocarditis is present. There is not the same objection to aspirin, and it is held by some that this drug should be used in preference to the salicylates if old-standing endocarditis is present when the patient first comes under observation. The balance of authority appears to be in favour of using salicylates even if cardiac complications are present. *Precordial pain* is met by the application of a small blister between the left clavicle and nipple. If the pain is very distressing, the continuous use of an ice-bag may be tried. The bag should be suspended from a cradle so that it does not press on the chest, and should be changed every two hours. The treatment of *acute pericarditis*, with or without effusion, is dealt with in a separate article. Apart from the usual treatment for pericarditis its occurrence in the course of acute rheumatism calls for no special remark.

Hyperpyrexia.—This complication is less common than formerly. The use of anti-pyretics is seldom of service, and in some instances actually harmful. The best treatment is the use of the cold bath. The patient should be gently lifted in a sheet into a bath at 90° F., which should now be rapidly cooled to 75° F. by the addition of ice. The patient should be taken out of the bath in fifteen minutes, or sooner if his temperature falls four degrees. As collapse sometimes occurs during the bathing, the patient must be closely watched. If collapse does occur, he must be removed at once from the bath and stimulated freely. If no symptoms of collapse occur, the bath may be repeated if the temperature again rises above 105°. If no bath is available, the patient should be enveloped in a sheet and rubbed with ice.

Relapse.—If a relapse occur, the treatment should be that prescribed at the onset of the original attack; full doses of the natural salicylates, free purgation with calomel, and diet consisting entirely of milk.

CONVALESCENCE.

When the temperature has been normal for ten days the salicylic mixture should be omitted. A tonic of iron and quinine may now be given, such as: Quinine Hydrochlor., gr. 2; Tinct. Ferri Perchlor., ♏10; Glycerin, ♏20; Inf. Aurant. Co., ad ʒj [U.S.P. Quininœ Hydrochlor., gr. 2; Tinct. Ferri Chlor., ♏7; Glycerin., ♏20; Inf. Aurantii Co., ad ʒj], twice a day after food. The diet should be varied and contain a sufficient quantity of green vegetables. Meat should only be taken once a day, preferably at the midday meal.

Exertion.—The regulation of the patient's movements during convalescence requires immense patience both on the part of the patient and his doctor. Too early movement or too rapid increase in the amount of exertion permitted may, and often does, cause irreparable heart mischief. It is not too much to say that if adequate attention were paid to this question during the convalescence of rheumatic fever, a large proportion of heart disease met with to-day and its attendant suffering would be avoided. If time is given, a heart seriously damaged by the attack may become adequately compensated for the extra work it has to meet, and the patient enabled later on to carry on an active life. If adequate time is not given at this period, the patient in too many instances is condemned to frequently recurring attacks of heart failure in after life. In all cases of acute rheumatic fever the muscle of the heart is affected to some extent, and in consequence of the myocarditis, there is frequently some dilatation; in other cases there is in addition endocarditis. In both classes, if the patient is permitted to move too soon, and so put an extra quantity of work upon the heart, the immediate result is that the dilatation becomes more marked, convalescence is always prolonged, and in some cases the patient loses his chance of establishing satisfactory compensation for the damage already done. In many instances, also, although there has been some myocarditis, there may be no appreciable dilatation, if the patient has received adequate treatment from the onset of the disease. Here, again, too early movement may be disastrous, in that the extra call on the softened heart muscle leads to dilatation.

The absolute rest in bed should be continued for ten days to a fortnight after the temperature has become normal. If there is now no evidence of a serious cardiac complication, and the pulse-rate has become regular and below 80, passive movements and gentle massage may be commenced. It is necessary that we should have some guide in order that we may know whether the amount of movement we prescribe is placing an undue load upon the heart. The condition of the pulse is our best guide. Whenever movement of any kind is permitted, a careful watch must be kept upon the pulse, and more especially upon its rapidity. If after any movement the pulse-rate is increased and remains at the higher level, the exercise permitted is too much for the heart muscle and is doing harm. When this occurs we must diminish the amount of exertion until it is within the capacity of the heart. As improvement sets in, the patient's shoulders may gradually be raised; he may then be allowed to sit up in bed. If progress is satisfactory he may then be moved to a sofa, and later allowed to get up and take exercise. Even in straightforward cases it is necessary to proceed very slowly, and two months or more after the temperature has become normal may be required for nursing the heart's muscle back to its normal load of work. Where the heart sounds are feeble, or there is definite evidence of endocarditis, we have to wait longer before any movement is allowed, and then to proceed even more slowly than in the ordinary cases (*see* article on Acute Endocarditis).

The Condition of the Joints.—The massage prescribed above, together with passive movements, is all the attention that is, as a rule, required for the joints. If the effusion has been very copious, it is sometimes of service to strap the joint firmly for a few days, but it is inadvisable to keep the joint fixed for any length of time. When there is considerable stiffness and pain in the affected joints, radiant-heat baths should be used in addition to the massage. If during convalescence there is some swelling of the joints, without fever, the effect of small blisters may be tried, whilst potassium iodide (gr. 5) may be given thrice daily.

Prophylaxis.—Exposure to cold and damp apparently play some part in determining an attack of acute rheumatism, especially in those who have already suffered from an attack. The clothing, occupation and climate should, therefore, be carefully considered in the case of susceptible people. As the infection probably gains its entrance to the body by the mouth, the teeth and the tonsils should receive attention.

ARTHUR LATHAM.

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ARTHUR LATHAM.

RHEUMATISM IN CHILDHOOD.

Rheumatism in childhood is a disease so different in type from that of adult life that its treatment presents certain problems and difficulties not encountered in later years. The key to the understanding of these is an exact knowledge of the symptomatology of the infantile type of rheumatism. In most text-books prominence is given to the adult type, thus overshadowing the less aggressive clinical features seen in childhood. Rheumatism is a protean malady, with its *primary* manifestations most frequently in childhood and adolescence; at this period the disease is essentially subacute and insidious in type.

Early rheumatism derives its enormous importance from the fact that there is the greatest possible risk of damage to the heart. A cardiac lesion may be the first rheumatic manifestation, may occur without very obvious arthritic symptoms and may recur and get worse in successive attacks. We might almost say that the whole aim of treatment in rheumatism is the prevention or minimising of cardiac mischief; in this respect we stand almost where we did and shall probably continue to do so until the fact is fully appreciated that about nine-tenths of primary rheumatic inflammations of the heart occur before the fifteenth year of life.

It follows from these considerations that the points which make for success in treatment at this age are prophylaxis and accurate and early diagnosis. These points can only be met by an accurate knowledge of the symptomatology and pathology; and it is therefore necessary here to cite briefly the main clinical features of early rheumatism. They may be summarised as follows:

(1) Family tendency.

(2) Certain peculiarities of physiognomy, skin and complexion in those specially liable to the incidence of the disease.[1]

(3) The various manifestations known as the "rheumatic series," the principal members of which are cardiac lesions (endo-, myo- and pericarditis), synovitis, fibrositis, fibrous nodules, "growing" pains, chorea, anæmia, pleurisy, tonsillitis and certain exudative erythemata.

(4) The incidence of the various lesions in this series in *any* order, and either singly or in combinations.

(5) The frequency with which any rheumatic manifestation of early life is complicated by a cardiac lesion.

(6) The joint manifestations are frequently inconspicuous or absent, and there is little, beyond "growing" pains, almost invariably regarded by parents as a normal phenomenon, to mark the insidious incidence of progress of irreparable cardiac mischief.

The special points in treatment that emerge from these facts are as follows:

(1) **Prophylaxis.**—Every child of a family known to be "rheumatic" (the word is here used in its strict sense only and of course does not include the rheumatoid and myalgic conditions, which occur more generally in later life) or who has at any time suffered from any rheumatic manifestation should be regarded as "suspect" till adolescence, at least, is passed. The parents should be cautioned to report the slightest pain or departure from perfect health. If the child is of the rheumatic "type" the necessity for this is the more urgent, and indeed the parents should be advised that the child should be examined at definite intervals, even if no definite symptoms occur.

This, it must be admitted, is a counsel of perfection, and many parents cannot or will not follow it, especially among the poorer and less intelligent section of the community. If the doctor is really convinced of the importance of such a line of treatment he will be able, however, from the very force of that conviction, to cause his views as to the seriousness of the risks which are being run, to prevail in many instances. The child should not be allowed to catch cold. This should be prevented by suitable clothing, the avoidance of wet feet (especially, perhaps, sitting in school in damp boots). Bathing, also, is another point to which attention must be paid. Cold baths are usually unsuitable in these cases.

(2) **The Treatment of every Rheumatic Manifestation as a Grave Disorder.**—Till this is done there will be little hope of lessening the appalling amount of cardiac disease which is to-day one of the reproaches to modern medicine. The occurrence of any symptom of the "rheumatic series" should mean instant confinement to bed and immediate examination of the heart. The latter procedure should be repeated daily during the active stage of the illness and at increasing intervals for a month or two following it. Even if no cardiac lesion can be detected, absolute rest in bed for not less than three weeks should be insisted upon. This treatment should be adopted even when the diagnosis is to some extent in doubt, as must often be the case. The risks are too great to admit of any other course and, after all, the little extra restriction involved by rest in bed is of small moment at this period of life.

(3) **Details of Treatment calling for Special Comment.**—In

regard to rest in bed, diet, clothing and management generally the treatment is the same as in adults.

Medicinal Treatment.—Salicylate of soda is the one drug upon which we rely. It should be given early and freely and continued for some time after the attack has subsided. Aspirin has been recommended but has no special value over the salicylate of soda and unpleasant toxic symptoms from its use have been observed. Sodium salicylate should be given in a dose proportionate to the age of the patient; from ¾ to 1¼ gr. for every year of age may be given, according to the severity of the attack. The doses should be two-hourly for the first four to six doses, then four to six-hourly, and thrice daily for a week after all pyrexia and other symptoms have subsided. If a relapse threatens the dose should be again increased. It has been shown that if this drug be combined with twice the dose of sodium bicarbonate toxic symptoms do not occur; in the writer's experience very large doses of sodium salicylate can in this way be given without unpleasant effects, and the combination should always be used for children. The limited solubility of the bicarbonate should be remembered and it should be given freely diluted. The bowels should be carefully regulated if the salicylate is for any reason being pushed. A cardiac lesion is no contra-indication to the employment of salicylates.

Cardiac Lesions.—In the vast majority of cases of rheumatism (possibly in all) it will be found that some dilatation of the heart can be detected by careful percussion. This fact alone emphasises the necessity for prolonged rest. Daily examinations should be made. If endocarditis occurs the treatment suggested by Caton may be tried; blisters about the size of a shilling are to be placed over the first four intercostal nerves in front of the axilla; a small poultice should be subsequently applied to the blistered area. Sodium iodide in doses of 2 gr. for a child aged ten should be given thrice daily, combined with small doses of calomel if the improvement in physical signs is tardy. Caton has obtained good results by this means combined, of course, with absolute rest, and his method is certainly worth a trial. In any case of endocarditis rest in bed should be insisted upon for at least two months after the subsidence of all active symptoms.

Pericarditis.—If this develops under observation the application of an ice-bag is probably of most service. This must be performed cautiously at first if there is much pain, the bag being suspended so as just to touch the surface. In the case of young children warmth must be maintained by hot bottles to the limbs and the temperature should be taken half-hourly for a few hours. Præcordial pain, restlessness and delirium may be relieved by a small dose of opium.

If the case comes under observation after pericarditis has developed, from three to six leeches should be applied to the præcordial area, except in very young or nervous children, to whom the procedure is alarming. The ice-bag should subsequently be used. Blisters to the præcordial area should not be used, as they interfere with the thorough examination of the heart. After an attack of pericarditis the patient should be kept in bed for from three to twelve months according to the severity of the case and the persistence of dilatation, rapid and irregular pulse, etc.

Relapses.—These should be guarded against by the continuance of the salicylate of soda as advised above. The liability to an increase of the cardiac lesion must always be borne in mind.

Joints and Fascial Phenomena.—These seldom require direct treatment in childhood other than protection by cotton-wool. The stiff necks and limbs yield to bed and salicylates, and the nodules require no direct treatment. Chronic stiffness of the joints is best treated by small doses of iodide of potassium.

Anæmia.—This is often rapid in onset and severe. During its continuance relapses are not infrequent. Iron should be given and may be combined with salicylate, if necessary.

The patient should always remain in bed while in an anæmic condition.

After-treatment.—Due attention should be paid to the various points mentioned under Prophylaxis. Special attention should be paid to the question of school and the elimination of strain, for it must be remembered that the rheumatic child is often the "nervous" child of the family. If a permanent cardiac lesion has developed exercise and occupation may require much modification and will be on the ordinary lines of patients suffering from valvular disease.

W. H. MAXWELL TELLING.

REFERENCE.

[1] Telling, W. H. Maxwell, "The Rheumatic Infection (a Clinical Study)," Practitioner, May, 1909, LXXXII., pp. 637-54.

RUBELLA.

Rubella is usually so mild a disease that no treatment is required beyond rest in bed while the rash is out and the temperature is raised. Often the temperature remains normal throughout the attack. In some cases the patient will feel somewhat out of sorts for a day or two, and will be content with milk diet; but as soon as his appetite returns he may be allowed his ordinary food. Complications and sequelæ are so rare as not to require discussion. The disease is feebly infectious, and the patient need not be isolated for longer than a week.

E. W. GOODALL.

SCARLET FEVER.

General Management.—During the acute stage of the illness the patient should always be kept in bed. The temperature of his room, which must be airy and thoroughly ventilated, should, if possible, not be allowed to rise above 60° F., nor fall below 55° F. Ventilation is of special importance under hospital conditions when a considerable number of patients live together in the same ward. Septic cases of scarlet fever in particular cannot be given too much fresh air. Adult patients who have had very mild attacks, with but slight fever lasting only two or three days, may be allowed to sit up in a dressing gown for a short time at the end of a week or ten days, and about three days later, put on their ordinary clothes. Provided the weather is suitable, such patients may begin to take outdoor exercise at the end of a fortnight. More serious cases will naturally advance more slowly. Some physicians prefer to keep even the mildest cases of scarlet fever in bed for a full three weeks from the commencement of the illness, believing that such treatment diminishes the risk of nephritis. If the patient is protected from chill, and proper attention is paid to the condition of the bowels, we do not think the possibility of this complication occurring need influence the physician in deciding when the patient shall be allowed to get up, except in the case of young children, who are undoubtedly better kept in bed until the end of the third week of illness. During the time that he is confined to bed the patient should be blanket-bathed every morning, and sponged over down to the waist, at any rate, in the evening. As soon as the pyrexia has subsided he should be given a warm bath at least every other evening: when getting up, the bath should be given immediately before going to bed. Such bathing keeps the skin active, and hastens the process of desquamation. The skin should be dried by the energetic application of a fairly rough towel, and the practice of daily anointing the surface with some oily preparation be adopted, the inunction being carried out on the patient's return to bed immediately after his bath. During convalescence the temperature should be taken night and morning, and the urine be tested at least every other day until the completion of the fourth week of the illness.

Twenty years ago desquamation was the great criterion of infectivity; at the present time it is entirely disregarded by the majority of fever experts in the later stages of scarlet fever. Its presence or absence is not considered to have any bearing on the fitness of the patient for discharge. The correctness of this view has been amply proved by the fact that its adoption in practice has nowhere led to an increase in the number of "return cases"; indeed, at some institutions its adoption has coincided with a diminution in the number of such cases, due, possibly, to the earlier removal from the atmosphere of a scarlet fever ward of patients who have had mild attacks of the disease.

Stickler's questionable experiment, the inoculation of healthy children with mucus from a scarlatinal throat, definitely proved that the infective element of scarlet fever has its headquarters, and, possibly, its only quarters, in the naso-pharynx; thus affording an explanation of the frequent persistence of infectivity of patients with a nasal discharge. It is probable that the cuticle, *per se*, is not at any time infectious, though it may doubtless act as a vehicle for the conveyance of dried discharge. A patient whose general health is good, and who has neither rhinorrhœa nor otorrhœa, may be released from isolation at the end of the fourth week of his illness, provided he is not returning to a family of young children. If such should be the case, it is wiser to keep him isolated a fortnight longer. Patients who can afford it should always go away to the seaside after an attack of scarlet fever. Should the convalescent have a slight watery rhinorrhœa, a frequent concomitant of adenoids, he ought to be detained until it clears up, or, at any rate, until isolation has lasted for a period of two months. A definite scarlatinal rhinitis, accompanied by thick purulent, or muco-purulent, discharge, is a most infectious condition, and one that is not easily cured. In a fever hospital such cases, where practicable, should be separated from the other patients, and, if necessary, detained for at least three months, or even longer. In spite of a detention of this length, one not infrequently hears that the discharge has reappeared after the patient's return home, often as a result of his having contracted a cold. Consequently, these cases, when released from isolation, should be kept away from other children, if possible, for another month, and sent away to the seaside if it can be managed. Patients affected with otorrhœa should remain under treatment, and if in hospital, kept there until the discharge ceases; or, at any rate, isolation should be maintained for a period of eight or ten weeks, not so much on account of the risk of their infecting other children, since this possibility is not supported by statistics, but because an uncured and neglected ear discharge may be productive of serious future consequences to the patient himself. Those who can afford to go to the seaside may be sent there after seven or eight weeks' isolation, it being understood that the ear-affection will still continue to receive attention.

In view of the possibility that a patient who is apparently quite fit for discharge may still carry the infective element of scarlet fever in his naso-pharynx, a warning notice in the following terms is given to the relatives of every patient before he leaves one of the fever hospitals of the Metropolitan Asylums Board :

"It is recommended :

(1) That for three weeks after leaving hospital the patient should not sleep in the same bed (or, if possible, in the same room) as children who have not had scarlet fever.

(2) That during this period articles used by the patient (such as cup, plate, spoon, handkerchiefs, towels and toys) should be kept distinct from those used by other children.

(3) That the patient should not attend school for three weeks.

"The above precautions are specially important in the case of patients suffering from a discharge from either *nose* or *ears*."

Diet.—During the pyrexial stage of simple scarlet fever this will consist entirely of milk. It is best given diluted, and may, if the patient prefers it, be flavoured with tea or coffee. It may also be given in the form of junket. An average allowance for an adult is 3 pints of milk per diem and 2 pints for a child. Home-made lemonade may also be given, and such fruits as grapes and oranges. As soon as the temperature becomes normal, bread and butter, eggs and farinaceous puddings may be added to the dietary, provided the tongue be clean and the fauces free from inflammation; a few days later the patient can be put on fish, to be followed in about a week by meat or poultry. Some practitioners, however, give nothing but milk for the first three weeks to even mild cases of scarlet fever, believing that an earlier return to solid food, especially meat, may be a factor in the causation of nephritis. This apprehension we believe to be groundless.

In the septic form of scarlet fever it is most important that the patient's strength should, as far as possible, be maintained by an ample supply of nourishment. If the case appears likely to be a severe one, it is a good plan from the first to give plasmon and lactose alternately in the two-hourly feeds, or an egg beaten up in milk twice a day. If the whole egg cannot be taken, the white alone can be given, while carefully made beef-tea is useful as a stimulant. Should weakness of the pulse, or the general condition of the patient, be regarded as an indication for alcohol a little brandy may be given; but it should be good brandy, in fact, the best procurable. It ought to be regarded strictly as a drug, and given in very small doses to children.

Cases with much swelling and ulceration of the fauces are often very troublesome to feed. The act of swallowing is so painful that it is frequently impossible to persuade a young child to take a sufficient amount of nourishment. Fortunately, this difficulty is easily overcome by the use of the nasal tube, by means of which food can be introduced into the stomach with ease and rapidity. If the child is pinned up in a large towel, or a draw-sheet wrapped round it so that it cannot use its arms, one nurse can quite well give the feed unassisted. This method of administering nourishment should be used for children in preference to nutrient enemata, unless persistent vomiting is a symptom of the illness. Adults are more tolerant of feeding by the bowel than young patients, and rectal injections may be used to supplement an inadequate supply of food by the mouth in cases where swallowing is very painful. In such cases the throat may be lightly sprayed two or three times in the twenty-four hours with a 4 per cent. solution of cocaine, and some milk given while the fauces are still anæsthetic.

In severe cases, whether of the septic or toxic variety, it is important to note the presence of gastric distension. Much harm may be done by pouring food into the stomach when it is not being digested. A stomach distended, whether by food or gas, is bound to interfere with the free action of the diaphragm, and may thus become a very serious embarrassment to the already weakened cardiac action. The remedy is to reduce the amount of milk, or to give it peptonised, or more diluted. The substitution of whey and meat juice for milk is often valuable.

REMEDIAL TREATMENT.

(1) Local.—The importance of local treatment varies with the severity of the case. For cleansing the fauces either gargling, syringing, or douching may be employed. Gargling is by far the least efficient of the three, though it may be ordered for adults where the faucial inflammation is so slight that it is a matter of little moment whether the condition be treated or not. Grown-up patients sometimes obtain considerable relief from steam inhalations. If the fauces are swollen, but not ulcerated, douching or spraying them four-hourly with hot water containing a little bicarbonate of soda or a weak antiseptic solution, such as boric acid, will be all that is required.

When, however, the tonsils and soft palate are ulcerated and covered with thick mucus, syringing is the most certain method of cleansing them. It is possible that in a few cases otitis media is set up by local treatment of the nose or throat, owing to septic matter being forced into the Eustachian tubes; but in septic scarlet fever the importance of thoroughly cleansing the fauces outweighs the risk of infecting the middle ear. Two 4-oz. rubber enema syringes should be employed for the operation, one being allowed to fill itself in the porringer of lotion while the other is being used. The nozzle of the syringes should not be more than 1½ inches long, otherwise there is a risk of damaging the soft palate in the event of the child moving its head suddenly. The patient should be wrapped up in a large towel or sheet, to prevent any struggling, and be sat up in bed, if his condition is not too serious. The nurse stands on the right hand side of the patient, and keeps his head firmly pressed against her left side while at the same time she bends it over the basin in front of her; she then passes the nozzle of the syringe between or behind the back teeth, so that the tongue does not intercept the stream of lotion, and proceeds to flush out the fauces thoroughly. Some nurses find it more convenient to sit on the edge of the bed instead of standing at the bedside when syringing a patient. The lotion must be ejected intermittently, in order that the child may draw its breath without obstruction. About a pint of the solution is used at each syringing. In the event of his being too ill to sit up, the patient should be laid on his right side and the syringing carried out with the head projecting slightly over the edge of the bed, so that the lotion as it runs out of the mouth may be received in a basin which the nurse supports in her lap while sitting in a chair beside him. In very severe cases it may be necessary to syringe the throat every two or three hours, unless the patient seems to be unduly exhausted by the operation. For cleansing these very dirty throats an acid solution containing free chlorine is most efficient. It is made as follows: An ounce of powdered chlorate of potash and ½ oz. of pure hydrochloric acid are placed in a Winchester quart, which is then stoppered lightly. When the bottle is full of chlorine gas, a few ounces of water are added, the stopper replaced and the bottle well shaken, to hasten absorption of the gas. The bottle should afterwards be gradually filled, restoppering and shaking it at intervals, so that the gas may be dissolved and not driven out of the bottle as the water is added. This lotion should be mixed with an equal amount of hot water before use, or with 2 parts for very young children. Adults will often prefer to have the lotion used cold, in which case a lump of ice may be put into it with advantage. Some physicians lay great stress on the application of antiseptics, such as lysol, izal or carbolic acid, by means of swabs to the necrosed and ulcerated surface. When this is limited in extent, and the patient quietly submits to the treatment, such applications may occasionally do good; but if the fauces are much ulcerated, and covered with mucus and offensive secretion, syringing the throat six or eight times in the twenty-four hours is necessary to keep it reasonably clean, and this involves quite as much disturbance as is good for the patient. After each syringing the toilet of the mouth should be carefully attended to, the roof, tongue, teeth and gums being cleansed by means of absorbent wool wrapped round the forefinger and dipped in clean chlorine lotion.

For cleansing the nares, when inflamed and discharging, a douche should be used in preference to a syringe, and no attempt should be made to force lotion through the nasal passages when they are blocked by swelling of the mucous membrane, or infective material is likely to be driven into the Eustachian tubes. A warm alkaline lotion, such as bicarbonate of soda, a drachm to the pint, is the best form of wash in the acute stage of a rhinitis, to be followed by antiseptic and weak astringent applications as the inflammation subsides. For this purpose a solution of boric acid is well suited.

(2) **General.**—No drug hitherto tried has been shown to be capable of exerting any direct effect on the course of scarlet fever. During the pyrexial stage a saline mixture may be given to encourage the action of the skin, but nauseating drugs should be avoided. They can have no influence on the course of the illness, and they may interfere with the proper taking of nourishment. On the other hand, it is important that the bowels should act regularly; consequently, the large intestine ought to be thoroughly emptied every day by means of a purge or an enema. For simple insomnia which does not yield to tepid sponging chloralamide is the best hypnotic. It produces no dangerous symptoms, and can be given with equal safety to infants and adults. In the writers' experience, the full dose may be repeated within an hour if necessary with perfect safety. Should the sleeplessness be due to faucial pain and discomfort, Dover's powder or liquor morphinæ hydrochloridi may be prescribed, provided there are no symptoms of nephritis. Should the patient become prostrate and in need of frequent stimulation, a mixture containing strychnine, if given alternately with alcohol, is usually productive of marked benefit.

Although much good work has been done during the last ten years by various observers, it must be confessed that the *serum treatment* of scarlet fever has so far been disappointing. The septic form of the disease, for which this treatment is especially adapted, is without doubt the result of a mixed infection, the presence of one or more strains of streptococci being the complicating factor in the case, and the one which is responsible for the septic symptoms. Since, unfortunately, there is every reason to believe that this condition of septic infection is dependent upon the operation of a number of different streptococci, a serum made from only one strain is likely to be of very little service. In view of this fact, polyvalent sera are now available, made from a large number (twenty to forty) of different strains of streptococci, and, to increase further the chances of success, the streptococci used in their preparation are taken from cases of scarlet fever. With sera prepared on these lines more encouraging results have been recorded, especially by Moser, Escherich and Bujwid. We ourselves have not only seen patients recover after this treatment whom we should have expected to die, but we have seen them improve with a rapidity seldom, if ever, equalled by cases not so treated. On the other hand, a large number of apparently equally suitable cases have been quite unaffected by the serum. Not less than 25 c.c. should be given to start with, while if the case is a severe one, or the treatment has been delayed until after the third day of the illness, the dose should be increased to 50 c.c. Another injection should be given at the end of twenty-four hours unless marked improvement has set in, and even in cases which seem to react to the serum, it is wise to repeat the injection in forty-eight hours' time.

Some years ago, owing to the courtesy of Dr. Besredka, of the Institut Pasteur, one of us was enabled to make trial of a serum which he had prepared from twenty separate strains of streptococci taken from various scarlatinal sources. This strictly anti-scarlatinal serum was tried on forty-four cases of septic scarlet fever of such degree of severity as would, in the opinion of the user, have probably proved fatal if treated by ordinary methods. The mortality of the cases treated not later than the fourth day of attack was 23·5 per cent.; of those treated on the fifth to the seventh day it was 35·2 per cent., while of those not treated till the eighth to the tenth day it was 50 per cent. The mortality of the whole series of forty-four cases was 36·3 per cent., which was certainly encouraging. In some instances the serum acted like a charm, the temperature falling within a few hours of injection; in others no effect was produced, but, apart from early injection, the special factors in the case which determined success or failure were not apparent.

The dose was in each instance 50 c.c., and the average number of injections per case was four.

Every care must be taken to render the operation aseptic, as the liability to suppuration at the site of injection is much greater after the use of anti-streptococcal serum than it is with diphtheria antitoxin.

One of us has recently been treating cases of septic scarlet fever with *a vaccine* consisting of sterilised cultures of scarlatinal streptococci. The vaccine was prepared by Dr. M. H. Gordon, the cultures being taken from streptococci isolated from the pharyngeal mucus, pus from a suppurating gland, and the heart's blood after death. The results so far have been very disappointing, but the number of cases treated has been small.

The same want of success seems to have attended the employment of vaccines made from the patients' own streptococci. This, nevertheless, is certainly a step in the right direction, but it is difficult to procure a vaccine made on this principle for extensive trial, and a polyvalent vaccine has usually to be employed as a substitute. Jochmann, of Berlin, reports having tried a vaccine in conjunction with anti-streptococcal serum and says that he obtained better results than he did when the serum alone was used.

Those physicians who look upon the desquamating cuticle as a primary source of infection naturally regard the application of an antiseptic ointment to the skin, or the daily inunction of oil of eucalyptus, so strongly advocated by Dr. Robert Milne, as an important part of the treatment. In private practice this might be carried out, partly because the patient's friends may expect it, and partly because it does, no doubt, assist in limiting the distribution of epidermal flakes, which may be carriers of dried nasal or faucial secretion. The value of anointing the skin with eucalyptus oil with the additional object of influencing the scarlatinal process is, to say the least of it, highly problematical.

The foregoing remarks on the treatment of scarlet fever refer to the simple and septic forms of the disease. *Toxic scarlet fever*, when well marked, is practically always fatal. Until something in the nature of an efficient anti-serum is forthcoming little can be done beyond endeavouring to sustain the patient's strength and promote elimination. The hypodermic administration of strychnine alternately with alcohol by mouth, and the free exhibition of water, if necessary by rectum, are likely to prove most useful. Dr. Claude Ker, of Edinburgh, has recorded recoveries as the result of intravenous injection of saline solution, and recommends that such injections should be preceded by venesection, the toxin circulating in the system being thus diminished both in quantity and in degree of concentration.

TREATMENT OF COMPLICATIONS.

Hyperpyrexia.—Despite the number of cases of scarlet fever which passes through a large fever hospital in the course of a year, one very rarely sees a patient with a temperature as high as 106° F., and even one of 105° F. is not so very common. Such temperatures, if the symptoms are not sufficiently urgent to call for prompt immersion in a cold bath, can be treated by cold or hot sponging. The latter, while not quite so efficient as cold sponging, can usually be relied on to diminish pyrexia sufficiently, and should be given the preference if the case be one of toxic scarlet fever or the rash be dusky and ill-developed. Water at a temperature of 110° F. is used, and the surface of the trunk freely exposed during the operation. The cold pack may be used as an alternative, in which case the sheet should be wrung out of cold or just tepid water, and the temperature of the pack gradually reduced by placing pieces of ice on it. These should be replaced as they melt, but the patient must be carefully watched and the pack removed in the event of definite shivering. Temperatures below 106° F. can, if necessary, be sufficiently reduced by partial sponging, the front and back of the trunk alone being treated. Of antipyretic drugs, antifebrin in doses of 2 to 5 gr. is the best, but the reduction of temperature by means of drugs is rarely to be recommended.

Otitis Media.—The first symptom of this complication is usually otorrhœa. In scarlet fever it is quite uncommon for pronounced earache and pyrexia to precede the perforation of the tympanic membrane. Consequently, the question of incising the drum rarely arises. Should earache be present, relief will usually follow the instillation of a few drops of warm tincture of opium or glycerine of carbolic acid, and the application of a fomentation to the side of the head. When otorrhœa is established, every effort must be made to keep the discharge sweet, and prevent it from becoming chronic. During the first week the ear should be douched four-hourly with warm boracic lotion, the external meatus being afterwards dried and loosely packed with sterilised wool, or, better still, iodoform gauze. Should the discharge be very profuse, so that it quickly soaks through the dressing, the douching and packing must be repeated more frequently. After the first week peroxide of hydrogen (10 vols.) and a solution of carbolic acid (1 in 80) should be tried alternately, while in the later stages of an otorrhœa astringent lotions, such as carbolic acid (1 in 80) containing 2 gr. to the ounce of sulphate of zinc, or a weak solution of chlorinated soda are likely to be more useful. A chronic otorrhœa will sometimes react to the stimulating effect of the occasional instillation of rectified spirit (1 in 4), gradually increased to equal parts of spirit and water. The same result may be obtained by laying the patient on his side with the affected ear upwards and filling the external auditory canal with hydrogen peroxide (20 vols.), which should be left in for five minutes. Should the inflammation spread backwards and involve the antrum, as shown by pyrexia of an irregular character and œdema and tenderness of the tissues lying over the mastoid process, that cavity should be freely opened and lightly packed with sterilised gauze. In private practice where such an operation is less easily carried out than in a hospital, the effect of freely incising the tissues down to the bone, including the periosteum, might first be tried, as it often proves sufficient. The advisability, or the reverse, of operative treatment of the middle ear when an otorrhœa has become thoroughly chronic, should be decided by an aural specialist.

Adenitis.—This condition, whether associated with faucial inflammation in the acute stage of the illness, when it can hardly be called a complication, or whether occurring as a primary affection of the cervical glands in convalescence, is best treated by the application of linseed poultices. These should be changed to boracic fomentations when it appears likely that the gland will suppurate. As soon as the skin becomes œdematous, even if no fluctuation is detected, one may be sure that pus is forming, and the sooner it is let out the better. For the purpose a local anæsthetic is usually sufficient.

Cervical Cellulitis.—This complication is only seen in the worst cases of septic scarlet fever, and is much less common than it was fifteen to twenty years ago. The skin of the neck, on one or both sides, becomes dull red in colour and board-like to the touch, the result of brawny induration. As soon as the condition becomes obvious the affected area should be freely incised, and hot boracic fomentations applied frequently. This will to some extent relieve the tension, and permit the escape of a thin serous discharge, true suppuration being rarely met with. The subcutaneous areolar tissue usually sloughs, and must be allowed to come away through the skin incisions. Cervical cellulitis arising during the acute stage of a septic attack as a rule proves fatal.

Arthritis.—The treatment of this affection will depend upon the character of the joint condition.

(1) *Scarlatinal synovitis*, or scarlatinal rheumatism, which occurs towards the end of the first week of the illness, and affects the joints of the wrist and fingers more often than any others, is

relieved by anti-rheumatic remedies, such as salicylate of soda and aspirin. These quite possibly have a sedative rather than a specific effect, since the relation of the condition to ordinary rheumatism is at least doubtful.

(2) *Septic arthritis*, which is caused by a streptococcal infection of the joint, may be either acute or chronic. The former, which is much the more serious and also the more common, occurs during the acute stage of septic scarlet fever ; while the chronic form seems rather to be associated with the later manifestations such as stomatitis and otitis media. Anti-streptococcal serum should be given at once, and if only one joint is affected, as is usually the case in the chronic variety, it should be opened by a free incision on each side and the interior thoroughly irrigated with boiled water, boracic lotion, or perchloride of mercury 1 in 4,000). A drainage tube is passed through the joint and absolute rest secured by means of a splint. When more than two joints are involved in acute septic arthritis, the patient very rarely recovers. Early operation is essential in these cases, in view of the risk of pus making its way out of the joint and burrowing among the muscles. Should this happen, the gravity of the case is immensely increased. Before opening a joint it is always well to draw off some of its contents with a syringe and fine needle, under strict aseptic precautions, for the purpose of examination. If the synovial fluid is only slightly turbid, the joint may be emptied and washed out through two small incisions, and no drainage tube inserted. It should then be dressed antiseptically and at once put upon a splint, equable and elastic pressure being maintained round the joint by means of a layer of cotton-wool and the firm application of a bandage. If, however, the fluid withdrawn by the needle is seropurulent, or if it collects again after the operation just mentioned, the joint should be freely opened, since less harm is likely to result from such a proceeding than from leaving a joint with infective material shut up in it. Joints such as the wrist and the ankle may often with advantage be kept for some hours at a time in a warm bath of weak antiseptic lotion after being opened. The drainage tube should be removed at the earliest possible date, as the irritation set up by its presence tends to cause adhesions. When once recovery is assured, every effort must be made to give the patient as useful a joint as possible. Gentle passive flexion and extension should therefore be practised as soon as the acute stage of the arthritis is over. This is preferable to the subsequent breaking down of adhesions under an anæsthetic.

(3) *Rheumatism* occasionally occurs late in the illness, and requires to be treated on ordinary anti-rheumatic principles.

Nephritis.—In the acute stage of scarlet fever a transient albuminuria, due to the pyrexia, is a common symptom, and does not call for special treatment. During convalescence this complication may occur in a more pronounced form, the time at which kidney trouble most often arises being towards the end of the third week and the beginning of the fourth. If the patient is up, he should at once return to bed and be put on a milk and farinaceous diet. The bowels should be opened daily, and the urine measured and tested regularly. Should hæmaturia appear, it points to the nephritis being acute, in which case the patient is placed between blankets and the diet restricted to milk. When, in addition, there is a marked decrease in the quantity of urine passed each day, diaphoresis should be encouraged by giving large quantities of water or barley water to drink, liquor ammoniæ acetatis or bitartrate of potash in full doses, and the application of heat to the surface, preferably by means of a hot-air bath, since this is less disturbing and more comfortable for the patient than a pack, and less debilitating than a vapour bath. Pilocarpine, if employed, should be given with caution. One-fifth of a grain hypodermically is a full dose for a child of six. Should the quantity of urine passed each day be very small, amounting to only a few ounces in the twenty-four hours, purgatives, such as jalap or scammony, which produce watery evacuations, must be used, and dry cupping of the loins may be tried in addition. If, in spite of this treatment, the patient's condition becomes worse, and uræmia gradually supervenes, bloodletting may with advantage be practised ; a couple of minims of croton oil should be given, preferably in a tablespoonful of milk, to effect a rapid and violent action of the bowels, and energetic measures taken to induce a copious sweating. Convulsions, if present, will generally yield to a few whiffs of chloroform, its administration, too, being of special value in allowing time for the other remedies to take effect ; indeed, a bottle of chloroform should always be kept at the bedside, once convulsions have appeared, in view of the possibility of their recurrence.

The milk diet should be continued until the amount of albumin has fallen to a heavy trace, when farinaceous foods may be given, followed in a few days by boiled egg and fish if improvement continue. When a considerable amount of albumin persists for more than three weeks, the diet should be increased on the same lines and iron also be given. The preparation which has always been most in favour is the tincture of the perchloride, but the saccharated carbonate appears to be equally serviceable.

Cases of nephritis which develop in hospital rarely exhibit any noticeable degree of œdema. This symptom is usually seen in patients who have not been suspected of suffering from scarlet fever until the appearance of dropsy and albuminuria has led to a general examination, when the presence of desquamation is detected. These cases are more likely to terminate fatally, and if recovery takes place are much slower in mending than those in which a definite nephritis develops under medical observation.

The patient, as a general rule, should be kept in bed as long as there is much albumin in the urine, but if this condition has lasted some weeks without improvement, it is better to try the effect of getting him up, as confinement to bed appears in some cases to encourage a persistence of the symptom. Before doing so, it is as well to submit him to a course of hot-air or vapour baths and energetic dry cupping, as this treatment will sometimes lead to renewed improvement in a case that had looked like becoming chronic. Patients who are left with a trace of albumin in the urine must take every possible care to avoid a chill, and, if they can afford to go abroad, should winter in a dry warm climate. For this purpose no place is better than Egypt. In treating these cases the practitioner must remember that scarlatinal nephritis very readily causes cardiac dilatation in young children.

Affections of the Heart.—Probably few practitioners realise in what a large proportion of cases of scarlet fever there is a recognisable dilatation of the heart during the early days of the illness. This may occur even in mild cases, consequently the position of the apex beat, and the quality of the cardiac sounds should always be determined before a child is allowed either to get up or to take active exercise. Simple dilatation is cured by rest in bed. When, however, from the character of the bruit there appears to be definite endocarditis, repeated small blisterings of the upper intercostal spaces, as practised by Caton, together with rest in bed and a course of iodide of iron, offers the best prospect of cure. Pericarditis is rarely seen. In addition to any operative measures which may be rendered necessary owing to the effusion having become purulent, or its amount excessive, this complication calls for prolonged rest in the recumbent position.

Ulcerative Stomatitis.—This complication generally appears towards the end of the second, or during the third week, in septic attacks. It usually begins in the neighbourhood of the lower incisors. The affected gums at first become spongy and readily bleed on pressure. They ultimately become gangrenous, the teeth loose, and the breath exceedingly offensive. The condition needs energetic treatment, or it will quickly spread, and finally cause death by broncho-pneumonia and exhaustion. It may sometimes be stopped by the application, under local anæsthesia, of pure carbolic acid to the affected gums and bone. In other cases nothing seems to affect its progress, though a thorough curetting of the affected tissues and the free application of fuming nitric acid will sometimes effect a cure. It is naturally of the highest importance that its presence should be detected, and treatment commenced at the earliest possible moment. A careful watch should therefore be kept on the condition of the gums and teeth, while an offensive condition of the breath is often the earliest indication of its onset. Milder forms of stomatitis are of common occurrence in septic scarlet fever. They are a source of discomfort to the patient rather than a danger to life, and can usually be cured by means of a mouthwash of Condy's fluid, and painting the affected surface with a solution of nitrate of silver (10 gr. to the ounce) twice daily.

F. FOORD CAIGER and H. E. CUFF.

SEPTICÆMIA AND PYÆMIA.

While it is possible by the clinical course and terminations of these diseases to make definite distinctions between them, their treatment differs only in detail. They will, therefore, be considered together. Treatment is local and general—the former directed to preventing the continued access of the invading organisms from the original focus of infection to the body generally, the latter to combating the results of or even destroying those which have already entered the tissues. Unfortunately it is difficult by any means short of amputation to ensure that local treatment shall have the desired result. Moreover, it is probable that, when the disease is contracted, the chief source of the organisms and their toxins is not the original focus of infection, but some internal organ, such as the spleen, which the organisms have chosen as their home. When there is a more or less shut-in cavity containing pus or a decomposing mass of blood clot, such as occurs in the case of clot and placental remains in the uterus or a suppurating hæmatoma, removal of such a mass, followed by irrigation of the cavity with saline solution or some weak antiseptic and provision for drainage, is called for. It may be that there is no invasion of the tissues or blood stream by the organism, but that the symptoms are the result of the absorption of toxins from the putrefying mass. The name *Sapræmia* has been applied to such cases. It is difficult in the absence of blood cultures to say definitely whether there has been an invasion of the blood stream with organisms or not, and only the success or failure of the above-mentioned local treatment in curing the general condition can decide the question. When there is a widespread local septic inflammatory process, and there is reasonable hope that the source of infection is limited to this, the question of amputation arises. The surgeon is faced with a condition of the utmost gravity, and the mistake must not be made of sacrificing life in the vain endeavour to save a limb. As examples in which amputation would be advisable may be quoted cases of septicæmia or pyæmia associated with spreading septic processes after compound fractures, or after the local treatment of acute infective osteo-myelitis. On the other hand, many cases of septicæmia are associated with comparatively trivial local lesions, or with a local lesion in which the inflammatory processes are at an end. Here amputation is useless and unjustifiable. The important source of the supply of toxins is clearly not the local disease, and amputation will only lower the patient's vitality without any compensatory advantage. The fact that amputation is at times inadvisable does not, however, affect the general rule, in cases of septicæmia, to endeavour to improve the local conditions by incisions, drainage and antiseptic treatment. If rigors and the other signs of pyæmia show that a thrombosed vein is discharging emboli into the circulation, immediate attention is directed to this. The affected vein is to be divided between ligatures at a healthy point on the cardiac side of the thrombosed portion. This having been done, the thrombosed part is, if possible, dissected away, together with any of the large tributaries. When this cannot be done the clot is cleared away by scraping and irrigation, after proximal ligature. This treatment has been chiefly adopted in cases of lateral sinus thrombosis from middle-ear disease in which the internal jugular vein is divided between ligatures in the lower part of the neck ; the lateral sinus is then exposed and opened and the entire contents cleared away, any bleeding being arrested by plugging. Similar principles of treatment have been adopted for puerperal pyæmia by ligaturing the pelvic veins. In the extremities also the main veins have been tied and thrombosed veins dissected away. Secondary abscesses in accessible regions in pyæmia should be opened as they occur, irrigated with a weak antiseptic lotion and drained. It will be necessary to keep a close watch for the development of these abscesses, as their appearance is often accompanied by so little in the way of local discomfort that the patient may make no complaint. The joints are the favourite external sites for these secondary abscesses.

Every endeavour is made by appropriate diet and the administration of stimulants to support the strength of the patient. The diet should be entirely fluid ; milk should be the main constituent (sodium citrate added in the proportion of 1 gr. to 1 oz. renders this more easily digested). Beef-tea and mutton broth, Brand's essence of beef, Valentine's meat juice, and the other meat extracts are of value. Beaten-up eggs should be given if they are retained by the stomach. Thirst should be alleviated by barley-water or imperial drink, or the milk may be diluted with mineral water, if the patient prefers it. Stimulants are necessary from the outset, brandy or whisky (in doses of 1 oz. every four hours) should be given to an adult. Champagne may be substituted for this, and is sometimes more effectual. Strychnine in the form of the liquor (♏ 1 to 5 [U.S.P. strychnin. hydrochlor. gr. $\frac{1}{110}$ to $\frac{1}{22}$ [hypodermically every four or six hours), or as the tincture of nux vomica (♏ 5 to 10 [U.S.P. ♏ 12 to 24] by the mouth), may be given as well as alcohol. Digitalin (gr. $\frac{1}{100}$) may be added to the strychnine for hypodermic injection, but three doses at most in the twenty-four hours suffice. Another form of stimulation is the administration of oxygen, allowed to bubble through a bottle containing absolute alcohol, as suggested by Collingwood. Inhalation is continued for five minutes in every half-hour or hour. The pulse rate will be found to diminish, and the blood pressure to rise. Normal saline should be introduced subcutaneously, in quantities of about ½ pint an hour. On occasions an intravenous injection of saline (2 to 4 pints) may be needed to tide the patient over a critical period. In the way of drugs, antipyretics such as quinine (gr. 5 every four hours if tolerated), salicylate of sodium (gr. 20 every four hours), phenacetin and antipyrine have been commonly employed. Their value is doubtful, and some of them are certainly depressants. Iron in the form of the tincture or liquor ferri perchloridi may be given in full doses (♏ 15 [U.S.P. tinctura ferri chloridi ♏ 12 or liquor ferri chloridi ♏ 4] every four hours). Opium is of great service when there is pain, restlessness or inability to sleep; its use is too often neglected in this condition. When the temperature rises above 103° F., tepid sponging lowers the fever and reduces the patient's discomfort. It should be carried out by sponging the patient with water at a temperature of 90° F., avoiding all unnecessary exposure.

In addition to the measures above detailed, endeavours have been made to attack the organisms themselves as they circulate in the blood stream or lie in internal organs and the tissues of the body generally. Three methods have been made use of: (1) By the injection of antiseptics directly into the venous circulation. Wassermuth has injected 6 cubic centimètres of a 2 per cent. solution of collargol into the median basilic vein, and claims success. Sulpho-carbolates have been administered internally with a similar aim in view; they are useless. (2) By the injection subcutaneously of serum from an animal which has been immunised to the effect of the organism concerned. Such serum is considered to contain a high proportion of antitoxic substances. Anti-streptococcal serum is the one which is applicable in septicæmia and pyæmia. The value of this serum is much disputed, and the most discordant accounts have been given of the results of its use. That there are many varieties of streptococci is established, and to be effective the serum must be from an animal immunised against the particular form from which the patient is suffering. To meet this difficulty many different forms of streptococci are employed in immunisation, and the resulting serum is known as *polyvalent*. Such a serum should always be selected. The dosage is usually 10 cubic centimètres three times a day, or 30 cubic centimètres in one dose repeated daily. (3) By the injection of vaccines. This line of treatment, introduced by Wright, is, in the writer's opinion, of great value. In cases of streptococcal infection a stock vaccine (a mixture of many strains of streptococci) may be used temporarily until a vaccine cultivated from the wound or blood of the patient is ready.

MAYNARD SMITH.

SINUS AND FISTULA.

THERE are many conditions which may cause a discharging opening to persist after incision into or spontaneous rupture of an abscess. Since the appropriate treatment is directly dependent upon the cause, it is necessary at the same time to consider the etiology.

(1) Some sinuses are consequent upon the fact that the discharge escapes with difficulty from the wound. Enlargement of the track of the sinus by forceps or knives, or a counter-opening for drainage will suffice.

(2) Where the sinus passes through muscular planes, insufficient rest may be responsible for preventing healing. In this case absolute rest must be provided. A roller bandage tightly applied or the use of a splint is sometimes immediately effectual in the case of a limb. Where the muscles concerned are in constant action and rest cannot be obtained, as in the case of anal fistula, division of the muscle (in this case the external sphincter) is called for.

(3) The possibility of the presence of a foreign body must be borne in mind. A bullet, fragment of clothing, a splinter of glass, a piece of wire, or, most commonly of all, a non-absorbable ligature, will prevent the healing of a sinus until removed. In this case the foreign body is to be taken away, and this entails as a rule the free enlargement of the sinus, the direction of which is ascertained by passing a probe. The skiagram will often be of service in localising the foreign body.

(4) A sequestrum or an area of carious bone is one of the most fruitful causes of a sinus. The position and extent of the affected bone, and the direction of the sinus, is ascertained by passing a probe, and by taking a skiagram of the affected part with a probe in the sinus, or after filling the sinus with bismuth emulsion. If the diseased bone be accessible, it is freely exposed; a loose sequestrum may be pulled away with sequestrum forceps, and an area of necrotic or carious bone is dealt with by means of a chisel or sharp spoon. When the bone is not freely accessible, as in some cases of spinal caries or disease of the pelvic bones, scraping with a long-handled spoon has to be resorted to; it is much less satisfactory than free exposure, and often fails to effect a closure of the sinus.

(5) When there has been a downgrowth of epithelium from the skin along the track of the sinus, this must be completely excised.

(6) The passage of irritating substances, such as bile, urine, fæces, saliva, etc., through a fistulous track will prevent healing. It may be stated as an axiom that when there is no obstruction to the flow of these secretions or excretions along their natural paths they will follow those paths, and the fistulous openings will close. Thus, dilatation of a stricture of the urethra in front of a perineal fistula, removal of a stone from the common duct in the case of a bilary fistula, dilatation of the nasal duct in the case of a lachrymal fistula, removal of an intestinal spur or dilatation of a stricture of the bowel in the case of a fæcal fistula, removal of a salivary calculus or the provision of a free opening of Stenson's duct into the mouth in the case of salivary fistula, are the essential points in the treatment of those conditions. In some cases, such as vesico-vaginal fistulæ, special operations are necessary, and are described in the appropriate sections.

(7) The presence of tuberculous disease in the wall of the sinus calls for special treatment, applied to the sinus on the lines about to be described.

Treatment.—In cases of short standing the removal of the cause is alone sufficient to ensure rapid healing of the sinus. When, however, the sinus is of long duration, its healing will entail, at the best, a long and tedious course of treatment even after the removal of the cause.

The treatment to be adopted in order to secure rapid healing of sinuses in general will therefore now be described.

It is to be understood that whilst the first object aimed at is to ascertain and remove the cause, this should in most cases be combined with one of the following methods for securing rapid healing :

(1) The sinus consists of a canal with a tough fibrous wall, lined with granulation tissue usually in a more or less unhealthy condition. The ideal form of treatment, and that which should always be adopted when possible, is to dissect out the sinus altogether. The orifice is cauterised by a Paquelin's cautery, and a probe is passed to the limits of the sinus. An elliptical incision is made enclosing the sinus and deepened, passing through the healthy tissues a short distance beyond the fibrous wall, until the whole track is free and may be removed entire. The wound is then completely closed, and absolute rest to the part is secured. Healing takes place by first intention in almost every instance where the removal has been complete.

(2) The anatomical relations and depth of the sinus may present obstacles to the above method of treatment. In this case, the orifice having been enlarged if necessary, the whole of the interior of the sinus should be thoroughly scraped with a sharp spoon, the cavity is then packed with strips of cyanide gauze, and, efficient rest being provided, an attempt is made to get the sinus to heal from the bottom. Instead of scraping the sinus its wall may be cauterised. This is by itself a less effectual measure, but may sometimes be advantageously combined with scraping. Chemical cauterisation, such as with liquid carbolic acid, chloride of zinc (gr. 40 to 1 oz.) on pledgets of wool, or solid silver nitrate fused on a probe, is often employed. The galvano-cautery is also used. A key in the handle for turning on the current should be provided; the end of the instrument is inserted to the bottom of the sinus, and the current having been turned on sufficiently to produce a dull red glow, the instrument is slowly withdrawn, the walls of the sinus being thoroughly burnt as this is done. Recently the injection of an emulsion of bismuth has been highly recommended by some to hasten the closing of the sinus (*see* Treatment of Fistulous Tracks in Empyema, p. 1110).

(3) When a sinus ramifies beneath the skin, failing the possibility of excision, it will usually be found necessary to slit up the sinus completely from end to end by means of a blunt-pointed bistoury, to scrape it, and to plug the cavity, leaving it to fill up by granulation.

MAYNARD SMITH.

SMALLPOX.

THE diagnosis of smallpox is a subject with which the private practitioner is intimately concerned. The treatment, it may be supposed, as regards the vast bulk of cases, concerns only the physician to the special hospital. Yet it is not too much to say that in the majority of critical cases it is only the private practitioner who counts. When the patient has left his hands the patient's fate is generally sealed.

Most patients who die, die of the fever of suppuration which is engendered by the specific rash. The fever is in proportion to the amount of the eruption, or, more particularly, to the amount of eruption which appears upon the face. The cardinal fact which decides the fate of the patient is the amount of eruption which the face sustains.*

Protective Measures.—Now assume that it is possible by artificial means to influence the distribution of the eruption of smallpox. Assume, especially, that it is possible to lessen its incidence upon the face. It would follow that it is possible to improve the prospects of the patient to a corresponding extent. Measures directed to such an end, to be effective, must be instituted quite early in the illness. They can therefore be instituted with success, as a rule, only by the private practitioner, and have become quite inapplicable by the time the patient has been admitted into hospital. In many cases even the private practitioner will become aware of the nature of the illness too late for remedial measures to be put into successful operation. But in a large number of instances the nature of the disease will be suspected from the first owing to the occurrence of previous cases. The specific rash develops some two or three days after the first symptoms of onset. It is when the practitioner has the patient under observation and is awaiting the development of the rash firm his suspicions that the one opportunity occurs for ally influencing the course of the patient's illness.

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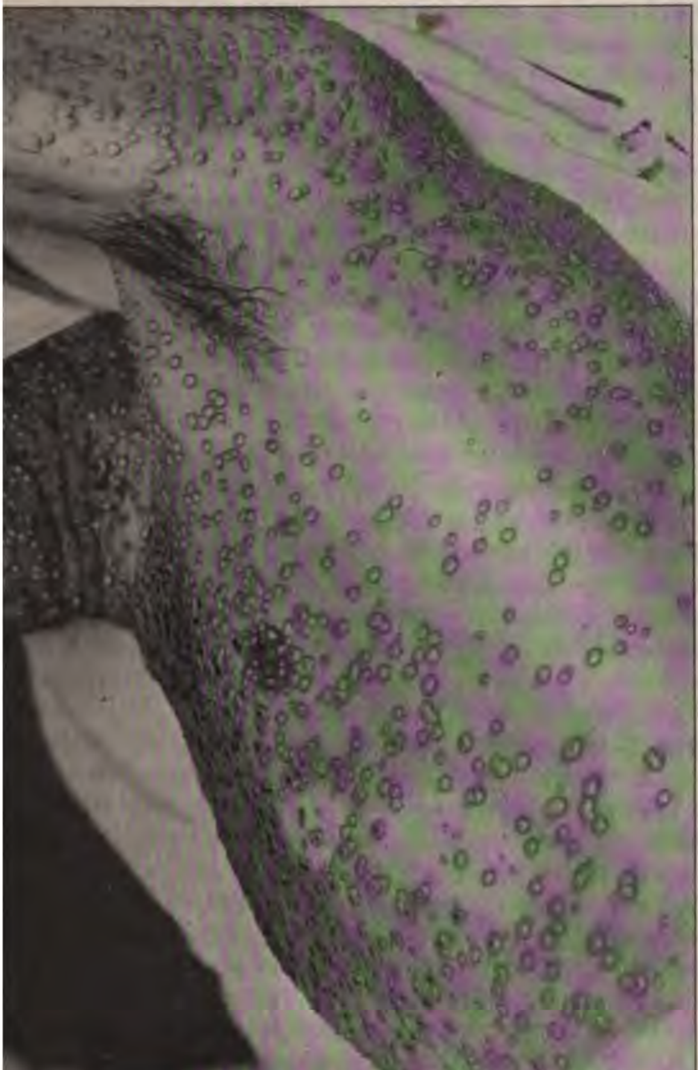
* "We must bear in mind that this disease is to be held dangerous, not in proportion to the thickness of the pustules on the trunk and extremities, but according to the number that show themselves on the face. If upon the face they lie as thick as sand, it is no advantage to have them few and far between on the rest of the body. The danger is as great as if every limb was beset by them. On the other hand, the trunk and extremities may be crowded with them to excess. If the face, however, be comparatively free, all is safe. Now what applies to the number of the pustules applies also to their character. It is the face that determines whether it be good or bad."—SYDENHAM.

writer has described elsewhere [1] the evidence which leads to



Axilla and flank of a patient with confluent smallpox. Though the rash was highly profuse on the face and abundant elsewhere, the immunity of the axilla was virtually complete.

clusion that the distribution of the papular eruption is not t in the disease but is occasioned by accidental circum-. The rash is attracted to those parts which are subject to irritation or exposure, such as the face and hands, and avoids the places which are sheltered and protected, such as the groins, the abdomen and the axilla. Furthermore, it is possible by irritating the skin to cause an unusual agglomeration of pustules on the part irritated; and by artificially protecting a part, usually exposed, to produce the opposite effect.

That it is possible to influence the distribution of the eruption by artificial means was known to some of the older physicians, and the knowledge was sometimes applied in the treatment of the disease. By the use of foot-baths and stimulating applications to the lower part of the body some attempted to attract the eruption to the trunk and lower extremities rather than to the face and arms. In point of fact, we do not know whether to exaggerate the density of the eruption on the lower part of the body is to diminish it on the upper part. The ancient line of treatment is therefore one which it is not fair to the patient to recommend. If, however, efforts are confined to protecting and screening the face and arms from the full severity of the eruption, we may be sure that nothing but benefit to the patient can accrue.

It must not be supposed that the possible benefit must necessarily be slight and problematical. Striking testimony to the contrary can be supplied by any case of confluent smallpox. An examination of the armpit will show that part of the skin to be almost devoid of lesions, even though the face be almost completely covered. The contrast, which is well brought out in the illustration, is due solely to the protection from irritation which the skin of the armpit enjoys by virtue of its position. If the skin of the face could be protected with equal efficiency during the last few days of the period of incubation and during the period of onset, the result would be equally marked. In practice such a perfect result could never be obtained, but the lesson taught by the immunity of the armpit should not be forgotten.

To be of use, the protective measures must be put in hand before there is any certainty about the case. Sometimes they will be vain because it will turn out, after all, that the patient has not got smallpox. Sometimes they will be futile because the attack is a mild one, and mild attacks require no special treatment. The uncertainty of the position must be expounded to the patient and his interest secured. Besides, the practitioner will not always be without some guide as to the necessity for adopting preventive measures. With vaccinated children under ten and with all persons showing evidence of recent successful re-vaccination, the precautions may be relaxed. On the other hand, they should be strictly enforced when the patient is unvaccinated or when the symptoms of onset are severe. The interval between the onset and the efflorescence is in most cases from forty-eight to seventy-two hours. The period of uncertainty, therefore, will not be tediously protracted.

The object to be attained is to protect the skin, more especially of the face, from all forms of irritation. The patient should be kept in a cool and equable temperature, protected from movement of the air, screened from the radiant heat of the sun or of a fire, and prevented as far as possible from touching the skin of the face. As soon as the first symptoms arise the patient should be kept in bed in a room fulfilling the conditions mentioned. Not only should open doors or windows be screened, but in addition special measures should be taken to protect the face from movements of the air. This object is best secured by covering the head with a veil. The material should be sufficiently open to allow the escape of heat and moisture from the breath. The most convenient plan is to attach to the head of the bed a curtain of mosquito netting and to arrange it over the upper part of the body, making sure that it does not touch the face. If the patient cannot be kept in bed or insists on sitting up, a veil may be worn, like those used by ladies, attached to a light framework worn after the manner of a lady's hat. The hands are very readily protected by a pair of comfortably fitting gloves, and, to prevent manipulation of the face, it is desirable, especially with children, to tether the wrists to the bedstead with check-strings.

Sedative or astringent applications to the skin are not to be recommended, because it is impossible to ensure a constant and continuous effect, and an intermittent effect would be harmful. There is much to be said, however, for the application to the face of a mask of some inert substance. Flexible collodion is, perhaps, the best application, the only objection to its use being that it is somewhat difficult to separate at a later stage of the illness. A spirit varnish, such as that used for coating photographic negatives, is a useful substitute. As soon as the film is dry, the application should be repeated several times. The stimulating effect of the solvents is unimportant as it is transitory.

The writer is inclined to recommend the administration during the pre-eruptive stage of the disease of small but frequent doses of belladonna and bromide to soothe the mind and to check any tendency to perspiration.

Unless it becomes clear that the attack is a mild one, the line of treatment indicated above should not be abandoned when the eruption appears but should be continued throughout the papular stage. The object to be gained under these circumstances is not to diminish the number of lesions but to limit the suppurative process. Experience shows that if a limb is protected by a layer of cotton-wool and a bandage applied when the eruption first appears—if the lesions, as it were, are put in splints—their subsequent evolution will be considerably modified. Some of the lesions will be abortive and in others the intensity of the suppurative process will be diminished. While, therefore, the face should be treated on lines similar to those already recommended, it may be desirable also to swathe the limbs, as soon as the eruption appears on them, if the case seems likely to be severe.

When the eruption has passed the papular stage, it is possible to form an accurate estimate of the prospects of the patient. In cases of confluent smallpox, as soon as vesiculation is well established, a different line of treatment should be adopted. The writer, like many others, is convinced of the beneficial effects of moist applications. Some authors make a point of the applications being cold, but in the writer's experience warm fomentations have much the same effect. It is of most importance that the applications should be made to the face, but in severe cases they may be applied also to the hands and feet and even to the whole of the limbs. Moisture is the essential, and Moore recommends a convenient means of ensuring this condition on the face, where it is difficult to keep compresses evenly applied. His plan is to make a mask of lint and to soak it in a solution of glycerine in iced water (ʒj to ℥j). The mask adheres to the face, keeps moist, and may be covered with a layer of oiled silk. The applications should be continued until dessication is well advanced. Continuous baths have been recommended, notably by Hebra; but though they have their value in particular cases, the writer does not recommend them as a routine treatment.

Numerous medicaments have been recommended by various authors but the effect of these is extremely problematical. Welch and Schamberg recommend painting the skin repeatedly with Tincture of Iodine undiluted, or, if that is irritating, half diluted. The application is to be continued from the first appearance of the eruption until it is well advanced in evolution. The authors claim that the treatment modifies the suppurative process and hastens scabbing. By repeated application the tincture forms a mask which presently cracks and peels away. It may be questioned whether the effect is more than would be produced by a mask of an inert substance. The writer would particularly discourage any line of treatment which involves breaking the surface of the lesions. The specific organism is pyogenic. The suppuration of the vesicle is not due to infection by pyogenic organisms from without. The vesicle is sterile; and the pustule is sterile when first formed. If the surface of the pock be prematurely broken, secondary infection will be sure to follow and the longer this can be delayed the better.

Much stir was created a few years ago by the announcement by Finsen that treatment in red light prevented the suppuration of the lesions and the consequent secondary fever. The writer has examined the published results and has found the evidence put forward in favour of this method of treatment to be entirely unconvincing. He has also experimented with selected cases and believes the treatment to be devoid of beneficial effect and in some cases actually detrimental to the general condition of the patient.

The application of oily matter to the skin is to be deprecated, at any rate until convalescence is established. It is of great importance to keep the skin clean and as aseptic as possible, and this object is more difficult of attainment if oil is applied. It should not be forgotten that pyæmia, now uncommon, was once a very frequent complication of smallpox. Bedsores can generally be avoided even when the patient is treated on a mattress; but sometimes it is desirable to use a water-bed. With young children and with delirious patients it is sometimes impossible to prevent such extensive injury to the face and other parts that the skin is left quite raw. Such cases are generally fatal.

As soon as dessication is thoroughly established every effort should be made to clear away the scabs as speedily as possible, especially from the face. To this end McCombie recommends a thin linseed poultice spread on lint and sprinkled with iodoform. It is expedient to hasten the process by the indefatigable use of the forceps.

General Management.—With regard to the general management of a case of smallpox, a salient fact to be remembered is that the disease renders the patient peculiarly liable to collapse and heart failure. A patient with confluent smallpox should always be handled with care and never subjected to unnecessary fatigue whatever the stage of the illness. It may be pointed out that, as the severity of the attack can seldom be gauged before the eruption appears, an attack of smallpox should always be regarded as a serious illness until the contrary is proved. That the patient appears capable of exertion is by no means an indication that exertion may be permitted. The warning is the more necessary in these days when it is the custom to send nearly all patients to hospital and when distance is sometimes considered no bar to removal. Undue exertion, though it may not kill the patient at the time, may obliterate his chance of recovery later on.

It is a curious trait of the disease that it engenders a great appetite which, though more apparent during convalescence, is also manifest earlier in the illness. Provided the food is digested, the more taken the better, as the disease makes great inroads on the patient's strength. But in severe cases care should be taken that the food is assimilable. Vomiting is sometimes troublesome. It is then desirable to peptonise the milk, and it may be necessary to resort for a time to rectal feeding.

The special drugs which have been recommended for smallpox are as numerous as the topical remedies and as inefficacious. With severe uncomplicated attacks the conditions which commonly call for medicinal interference are heart failure, insomnia and delirium. In severe cases of ordinary type anything but the occasional use of stimulants should be avoided until the secondary fever is well advanced. At the latter part of the secondary fever it may mean the difference between life and death to be able to spur, by the use of stimulants for two or three days, a flagging heart which has not become inured to them. There need then be no hesitation in pushing their use, but the pulse should be carefully watched to note the effect produced.

Opium is a drug which there is much temptation to employ to allay the irritation of the skin or to relieve insomnia or delirium. But the drug should be used with the greatest caution, especially late in the illness, on account of its depressing effect upon the heart. Delirium, though it may occur earlier in the illness, assumes its worst form during the fever of suppuration. One has then sometimes to choose between allowing the patient to exhaust himself by his struggles and administering a powerful sedative which may have a depressing effect upon the heart. Of sedatives, other than opium, the writer has found paraldehyde to be the most useful, but it often fails.

Pyrexia seldom calls for interference and is then best met by cold sponging.

Complications.—A common and dangerous complication of the secondary fever is *broncho-pneumonia.* There is no special treatment to be recommended beyond the measures ordinarily adopted for such a condition. Laryngitis is sometimes troublesome and is best treated with steam inhalations. A troublesome complication, or rather sequela, is the development of boils and abscesses. Sometimes there is extensive cellulitis. Early surgical interference is desirable in such cases to diminish the risk of pyæmia. Patients with smallpox are peculiarly susceptible to erysipelas. In hospital practice such cases should be isolated, as the disease may spread rapidly from case to case.

Of all the secondary infections perhaps the most important are *affections of the eye*. These commonly develop during the latter part of the secondary fever or at its termination. They are amenable to treatment, but, if neglected, they may lead to serious impairment of vision, loss of sight, or even to the loss of one or both eyes. Smallpox formerly was the commonest cause of blindness.

The commonest affection is simple subacute conjunctivitis, but conjunctivitis may occur in an acute and virulent form. Phlyctenules are frequent and are often the starting points of spreading ulceration. Ulcers may be benign and superficial, or spreading, or necrotic. Iritis is frequent in association with other morbid conditions.

As soon as the eye becomes affected frequent irrigation should be practised and the eyes covered with a shade. If conjunctivitis is acute much benefit will be derived from bulky hot fomentations. Leeches also are sometimes usefully employed. Subacute conjunctivitis is best treated with astringent lotions, such as sulphate of zinc or nitrate of silver (gr. 2 to ℥j).

Phlyctenules and simple corneal ulcers generally yield to the application of diluted yellow oxide of mercury ointment ʒss to ℥j of vaseline or stronger). Should the ulcer spread, the eye should be washed out with a solution of perchloride of mercury (1 in 5,000 or stronger) and iodoform ointment (ʒj to ℥j) should be inserted into the eye after each irrigation. If iritis is present, the eye should be kept dilated with atropin. Iritis is not often a serious complication, but occasionally it is very severe and becomes the dominant feature of the case. Leeches and hot fomentations are then the most useful remedies. Even when no iritis is present, atropin often proves a useful adjunct in the treatment of corneal ulcer, especially when there is not much conjunctivitis. But cases of the severer sort often do better with eserin. The effect of either remedy should be carefully watched.

When a corneal ulcer has an infiltrated or necrotic edge or floor and does not respond to less drastic measures, recourse should be had without delay to the actual cautery. An electric cautery is by far the most convenient. The infiltrated tissue should be burnt away very thoroughly. Iodoform ointment should be used for after-treatment, and the operation should be repeated if there are signs of a recurrence of the infection. The infective process is sometimes extremely rapid and virulent and brooks of no delay. If no cautery is available, the floor or edge of the ulcer may be scraped.

Varieties of Smallpox.—In discussing the treatment of smallpox of ordinary character it is not necessary to distinguish between the various forms which the disease may assume. The difference is one of degree. But a few words may be devoted to that type of the disease which is called toxic or hæmorrhagic smallpox. In ordinary cases the important part of the illness is the secondary or suppurative fever caused by the suppuration of the specific lesions. But the secondary fever is preceded by a primary fever, or fever of intoxication. The duration of the primary fever is upwards of a week, and in most cases it is a subordinate part of the illness. There are cases, however, in which the fever of intoxication is of a grave character and patients who suffer in that way commonly develop hæmorrhagic symptoms.

In the writer's experience the hæmorrhagic manifestations are not amenable to treatment, though such remedies as ergot, turpentine and large doses of perchloride of iron have been recommended by some. In point of fact these patients do not die of hæmorrhage but of cardiac failure. The exhibition of cardiac stimulants is therefore the most rational line of treatment. Though patients with toxic smallpox seldom survive, they not infrequently survive the toxæmic fever. They are then killed either by œdema of the lungs, a condition which is hardly amenable to treatment, or by the subsequent secondary fever. To endeavour to limit the eruption and the eruptive fever is, therefore, the most hopeful line of treatment for most cases of toxic as well as for cases of ordinary confluent smallpox.

Quarantine.—The period of quarantine for smallpox should be not less than fifteen days. A patient with smallpox should be kept in isolation until all the crusts have separated. The disease is not ordinarily very infectious before the eruption has appeared, but this rule does not always apply to cases of toxic smallpox and to cases in which the symptoms of intoxication are unusually severe. The corpse of a patient dead of smallpox is infectious.

Anointing the skin has been recommended as a measure calculated to render the infection less diffusible. The thesis would be difficult of proof; and during convalescence, the only time when inunction is permissible, the disease appears to be considerably less infectious than during the preceding eruptive period.

T. F. RICKETTS.

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VACCINATION.

SPECULATION as to the nature of vaccinia has lost its ancient zest. That vaccination protects against smallpox may now be regarded as proof that vaccinia and smallpox are pathologically one. The contrast between the clinical effects of the two infections is less striking when it is remembered that the difference between vaccinia and inoculated smallpox is no greater than that between inoculated smallpox and the natural disease. Vaccinia is smallpox shorn of the faculty of blood infection.

The genealogies of most of the strains of vaccine lymph in commerce are probably imperfectly known. While some may date back to the true cow-pox, some have doubtless a variolous origin. The distinction is unimportant. No doubt the Jennerian cow-pox, which was once so common, was consequent upon the prevalence of human smallpox, the accidental infection of dairy stock and subsequent transmission from cow to cow.

The protective effect of vaccination may last a lifetime, and with a large number of people some degree of immunity is retained through life so that an attack of smallpox, if sustained, is of a modified character. The least duration of complete immunity may be taken to be two years, but in the great majority of cases the duration is five years and upwards. As a general rule, the first re-vaccination should be practised between the ages of five and ten years. In many instances re-vaccination in childhood does not confer permanent immunity. A third vaccination in early life is therefore to be recommended.

With persons living in or entering a hospital for smallpox or in attendance upon patients with smallpox, greater precautions should be taken. Re-vaccination should be practised unless there is clear evidence of a successful operation within two years. At intervals of not more than five years the operation should be repeated. Insusceptibility to vaccinia is proof of insusceptibility to smallpox.

The question is frequently asked, can protection by vaccination be conferred after exposure to infection of smallpox? A successful vaccination done within three days of the date of exposure will, in general, wholly prevent the attack. If done within ten days of exposure vaccination will generally modify the attack, but if done later will certainly be without effect. These rules are not without exceptions because the pertinent date is, not when the operation was undertaken, but when the reaction begins. The vaccinal papule is generally evident by the third day after inoculation, but in exceptional cases its appearance is delayed for fully a week. In such instances there will be a corresponding delay in the rise of immunity.

The hope is sometimes cherished that vaccination done after the onset of smallpox, or even after the efflorescence, will have some curative or preventive effect upon the disease. Such a notion is entirely without foundation.

The modern methods of purifying calf lymph by the use of glycerine and chloroform have rightly caused the use of human vaccine lymph to fall into disrepute. Practically the only risk to be guarded against is that the lymph may be inert. Inert lymph may be caused by prolonged storage, though glycerinated lymph, if kept cool, will remain active for many months. Strains of vaccine occasionally deteriorate and become almost inert in the human subject though the local reaction in the calf may be normal. If there is a suspicion that such an event has happened, the lymph should be tested on the same subject with lymph of a different strain.

The best instrument to use for the inoculation is a narrow platinum-bladed knife with an iridium point. This can readily be sterilised, without injury, in the flame of a spirit lamp. In conducting the operation the best and simplest plan is to deposit the lymph on the skin by a blower and to cross-hatch through the lymph with the point of the knife. The incisions should just penetrate the epidermis, so that colour is seen but no bleeding caused. The area scarified need not be more than ¼ in. in diameter. Failure to produce a successful result is frequently the fault of the operator. The incisions may be too deep or not deep enough, and the failure is sometimes due to the unsuitability of the instrument used. Patent vaccinating instruments are not to be recommended.

The skin should be carefully cleansed before the operation, and afterwards an aseptic pad should be applied and firmly fixed with adhesive plaster and a bandage. As much care should be taken in the after-treatment of the arm as in the case of any other surgical wound. The reaction will not attain its height for about a week. The arm should be kept at rest and, if there is much inflammation and swelling, the best treatment consists in the application of hot fomentations. Sometimes there is extensive redness and swelling of the whole upper extremity, which may call for the application of astringent lotions to the forearm. When the inflammation has subsided a boracic ointment dressing is all that is necessary.

The most serious complications which are apt to occur are deep and spreading ulceration, cellulitis and erysipelas. These conditions are indicative of secondary infection and are therefore preventable. Their treatment does not differ from that of similar surgical cases due to other causes.

Many skin affections, diseases and ailments are ascribed to vaccination only because they synchronise with or follow the operation. There are, however, certain cases in which the local reaction is accompanied or followed by the development on other parts of the body of an eruption which is the consequence of the vaccinal lesion. Putting aside cases of auto-infection with vaccine matter and cases in which secondary vesicles develop round the parent ones from infection through the lymph channels, the eruptions which are met with may generally be regarded as toxæmic rashes. They commonly take the form of lichenous or urticarial rashes and soon disappear. In rare cases there is a true generalisation of vaccinia through the blood stream. The spots, as a rule, are not numerous and resemble extremely modified variolous lesions. None of these rashes require any special treatment.

If the operation is unsuccessful, it should be repeated once or twice. Even experienced operators can never be sure of eliminating all accidental causes of failure. With infants it may be accepted that none are insusceptible. After re-vaccination the reaction is often ambiguous, and it may be very difficult to decide whether the result was successful. Localised redness and swelling often follow an unsuccessful operation. Short of a definite vesicle, the only evidence which should be accepted as indicative of a successful re-vaccination is a circumscribed, deep-seated, indurated swelling of the skin under the seat of inoculation, developing about three days after the operation; even such a result should be confirmed by a subsequent inoculation. In the cases of infants the operator should be satisfied with nothing but a definite vesicle.

The number of insertions which should be made at one time is a matter which must be left to the discretion of the operator. Probably the greater the number of insertions the greater the duration of the protection; but it may be regarded as certain that the duration of the protection is not in arithmetical proportion to the number of the insertions. No doubt the ideal practice would be to vaccinate infants in one, or at most in two places, and to re-vaccinate at the age of five. But the operator has to be influenced by the consideration that the infantile vaccination will probably be the only one ever practised.

Except in cases of urgent necessity, no one should be vaccinated who is not in good health. The operator should be particularly cautious in the cases of debilitated children and those with cutaneous eruptions. Such children make bad subjects for the operation, and any ailment which they may subsequently develop will almost certainly be attributed, rightly or wrongly, to the vaccinal operation.

T. F. RICKETTS.

SOFT CHANCRE.

Soft Chancre or chancroid is a form of venereal ulcer, situated usually on the genital organs, highly contagious in nature, with a tendency to spread rapidly and to multiply indefinitely, and due to inoculation with the strepto-bacillus of Ducrey. If the patient is seen early before the sore has had time to inoculate the neighbouring parts, the treatment is to attempt to destroy the bacillus by means of caustic applications, and so prevent its infecting the inguinal glands. One of the most efficient caustics is Ricord's paste, consisting of strong sulphuric acid and finely powdered willow charcoal; this is spread over the sore and a short distance beyond its circumference, and it has the advantage over liquid preparations, such as nitric acid and solutions of caustic potash in that it has not the same tendency to spread to surrounding healthy tissues. Another method of treatment is by thoroughly scraping the surface of the ulcer and then applying pure carbolic acid. Treatment by caustics is inapplicable in cases of multiple sores, as the surface to be cauterised is then too extensive. Under those circumstances a paste composed of iodoform, charcoal and glycerine is a more suitable application, or the sores may be dusted with iodoform, iodol, dermatol or europhen powder. If situated on the inner surface of the prepuce they are liable to cause phimosis, and sloughing of the dorsum of the prepuce may ensue unless the sores are fully exposed by a free dorsal incision. Should they become phagedænic, they should be treated by placing the patient in a hot hip bath for from three to six hours daily, and after the bath lint soaked in lotio ferri. pot. tart. (gr. 20 ad Aq. ℥j) should be kept in contact with the sores.

A very frequent complication of chancroids is a suppurating bubo, which is termed a virulent bubo if inoculated with the bacillus of Ducrey; such a bubo must be freely opened and scraped, and the resulting surface freely touched with pure carbolic acid.

J. ERNEST LANE.

SYPHILIS.

The difficulties in the early diagnosis of syphilis have been materially lessened by bacteriological examinations of the secretion of the suspected chancre, since the presence or absence of the *Treponema pallidum* will enable the surgeon to arrive at a definite conclusion as to the nature of the sore and to commence the treatment at the earliest possible opportunity.

The chancre, or initial lesion of the disease, requires local treatment, but tends to heal directly the patient is placed on anti-syphilitic treatment; the most convenient applications are powders such as calomel, europhen, dermatol, iodol, dusted over the sore twice daily. Lotions may be employed instead of powder when the chancre is situated in regions where the latter cannot easily be kept in contact; those most commonly in use are the lotio nigra and lotio plumbi, with the addition of liq. opii sedativus, in the proportion of ʒj ad ℥j, if the sore is a painful one; solutions of hydrogen peroxide or Sanitas are indicated if the discharge is offensive. Occasionally the initial lesion, especially when situated beneath a tight prepuce, is complicated by a process of ulceration and sloughing known as **phagedæna**, which spreads with such rapidity that the penis may be destroyed in the course of a few days. For this condition energetic local measures are required; the sore should be fully exposed by slitting up the prepuce if situated in that locality, and touched freely with pure carbolic acid; the patient should be placed in a hip bath full of hot water, and should remain there for periods of from three to six hours; when not immersed in the bath, a valuable application is the lotio ferri tartratis (20 gr. ad ℥j), and iron may also be administered internally, as the patient is usually in an anæmic and depressed condition. Excision of the chancre is a treatment to be highly commended whenever it is situated in a locality convenient for its complete removal without much mutilation, such as the preputial orifice; here circumcision is a most desirable measure, for the early ablation of the chancre does certainly materially modify the subsequent course of the disease, and in some cases it appears to arrest its further evolution.

Constitutional Treatment should be commenced immediately the diagnosis of syphilis has been arrived at, and the drug on which the most reliance is to be placed is mercury. There are many methods by which mercury may be introduced into the system, *e.g.*, by oral administration in the form of pills or mixture; by inunction, or the rubbing into the skin of mercurial ointment; by intramuscular injections of various preparations of mercury; by intravenous injections; by fumigations; by rectal administration and by inhalation. It is impossible to dogmatise as to which is the best method of treatment of a disease presenting so many variations and complications as syphilis, and the surgeon will do well to make himself familiar with each plan, and to adopt one or the other according to the individual requirements and environments of the case.

In severe and destructive lesions the treatment must necessarily be drastic, whilst mild and uncomplicated cases will yield to the simplest of measures; indeed, it may be said that ordinary cases of syphilis are thoroughly amenable to treatment, and a large proportion of them can be brought to a satisfactory conclusion by the administration of mercurial pills or mixtures such as the following: ℞. Hydrarg. c̄ Creta, Pulv. Ipecac. Co. [U.S.P. Pulv. Ipecac. et Opii.], āā gr. 1; ft. pil. t.d.s. post cib. ℞. Hydrarg. Tannatis., gr. 1; Ext. Cinchonæ, gr. 2; ft. pil. t.d.s. post cib. ℞. Pil. Hydrarg. [U.S.P. Massa Hydrarg.], gr. 1 ad gr. 2; t.d.s. post cib. ℞. Hydrarg. Iod. Virid., gr. $\frac{1}{3}$; Ext. Cinchonæ, gr. 2; ft. pil. t.d.s. post cib. ℞. Liq. Hydrarg. Perchlor., ʒj; Inf. Gentian. Co., ad ℥j [U.S.P. ℞. Hydrarg. Chlorid. Corrosiv., gr. $\frac{1}{16}$; Inf. Gent. Co., ad ℥j.]; ft. mist. t.d.s. post cib. ℞. Liq. Hydrarg. Perchlor., ʒj; Sodii vel Ammonii Iodidi, gr. 5; Tr. Nucis Vom., ♏5; Syrup. Aurantii, ʒj ;Aq. Camph., ad ℥j [U.S.P. ℞. Hydrarg. Chlorid. Corrosiv., gr. $\frac{1}{16}$; Sodii vel Ammonii Iodidi, gr. 5; Tr. Nucis Vom., ♏12; Syrup. Aurantii, ʒj; Aq. Camph., ʒij; Aquam, ad ℥j.]; ft. mist. t.d.s. post cib. ℞. Sol. Donovani, ♏15; Sodii Iodidi, gr. 5; Sodii Bicarb., gr. 20; Tr. Card. Co., ♏15; Aq. Camph., ad ℥j [U.S.P. ℞. Lig. Arsen. et Hydrarg Iodid., ♏15; Sodii Iodidi, gr. 5; Sodii Bicarb., gr. 20; Tr. Card. Co., ♏15; Aq. Camph., ʒij.; Aquam ad ℥j]; ft. mist. t.d.s. post cib.

It is rather the custom nowadays to decry the older, the simpler and the more familiar plans of treatment, and to advocate measures which are attended by inconvenience and discomfort to the patient, but, in justification of the administration of mercury by the mouth, the opinion and experience of such an authority as Professor Fournier must still be treated with some respect. Fournier designates it "the true method of the treatment of syphilis." His preference for it is due to the fact that it is "practical, in the precise and complete sense of the word, that is to say, it is easy and convenient, as well as certain in its merits. It is right to consider the patient's point of view by choosing the method of treatment most suitable to his occupations, convenience, and social and professional obligations."

One of the requisite concomitants of every method of mercurial treatment is the strictest attention to *the hygiene of the mouth.* At the commencement of the course the co-operation of the dentist is frequently required. Carious teeth should be filled, useless stumps extracted, and tartar should be removed by scraping. The teeth should be most carefully cleansed with some antiseptic tooth powder or lotion two or three times daily, and the mouth should be occasionally washed with some astringent solution, such as alum, Listerine or Sanitas. The mouth wash in habitual use at Aachen consists of : Liq. Aluminii Acetici (*German Pharmacopœia*), ʒij ; Aq. Floris Aurantii, ad ʒviij.

In those whose gums are unusually susceptible to the action of mercury, as evidenced by gingivitis with a tendency to hæmorrhage on slight provocation, a solution of copper sulphate (10 gr. ad aq. ʒj), may be painted on two or three times daily. The diet should be simple but nourishing, and the habitual use of stimulants, especially of spirits, must be prohibited. Smoking in moderation may be indulged in, but should be forbidden in cases in which there is ulceration of the fauces or any part of the buccal mucous membrane ; or in which any form of glossitis is present.

Cases are, however, frequently met with in which the patient is intolerant of any form of mercury administered by the mouth, some part of the alimentary tract rebelling against its introduction ; there are also the cases of unusually severe syphilis to be considered, in which it is essential that the patient should be got under the influence of the drug with the least possible delay; cases, for instance, of rapidly spreading ulceration threatening mutilation and disfigurement; severe cases of iritis which might ultimately entail loss of vision ; also cases of malignant syphilis and of visceral or nervous lesions.

Under such conditions some alternative plan of treatment is indicated, and of the methods already alluded to, that by **intramuscular injections** will usually fulfil the requirements of the case. These injections may be divided into two categories, the insoluble and the soluble salts of mercury, and of the two the insoluble are far the more satisfactory, since they are characterised both by the intensity and by the rapidity of their action. Of the insoluble salts calomel has by far the most powerful effect; it is administered according to the age, weight, sex and general condition of the patient in doses of ½ to ⅔ gr. finely triturated and suspended in 15 to 20 min. of sterilised olive oil. A point midway between the anterior superior spine of the ilium and the summit of the intergluteal fold is the one usually selected, the needle is plunged deeply into the substance of the glutei, the fluid is introduced slowly, and the region is subsequently massaged for a brief period. The usual precautions as to asepsis must be strictly observed, the syringe and needle must be sterilised by heat and the skin thoroughly cleansed with a solution of bin-iodide of mercury and rectified spirit in the proportion of 1 to 500. These injections are made at intervals of a week into right and left buttock alternately, and a course of twelve injections is usually sufficient to get the patient well under the influence of mercury and to clear up all urgent symptoms. Another efficient, though not so powerful a preparation is grey oil, consisting of Hydrargyri, ʒss; Adipis Lanæ. Anhyd., ʒij; Paraffin. Liquid. (carbolisat. ad 2 per cent.) ad ʒv. The dose of this is 10 min., containing 1 gr. of mercury, injected weekly, for twelve weeks or more. In cases of less urgency the basic salicylate of mercury may be utilised, 10 gr. of the salt being suspended in 100 min. of liquid paraffin, the dose of the preparation being from 10 to 15 min. weekly. The insoluble injections may give rise to considerable pain, resembling sciatica and lasting for three or four days; they may be followed by nodosities of the buttock, proceeding in a few instances to abscess formation, and cases of pulmonary embolism, some of them fatal, have been recorded; the dangers and disadvantages have been somewhat exaggerated, and with ordinary precautions, it is both safe and efficient. Injections of the soluble salts of mercury are also recommended in the treatment of syphilis; they have the advantage over the insoluble preparations that they are not nearly so painful, but the disadvantage that they have to be introduced daily, and that a course of at least thirty injections is required before the patient is placed sufficiently under the influence of the drug for it to have the desired effect upon the urgent symptoms of the disease. The preparations most in vogue are Hydrarg. Perchlor. gr. ⅓ in ♏15 of distilled water; Hydrarg. Succinimide, gr. ⅓; Hydrarg. Biniod., gr. ⅓; Hydrarg. Sozoiodolate, gr. ⅓, with Sodii Iodidi, gr. ⅔; Hydrarg. Lactatis, gr. ⅓; Hydrarg. Oxyd. c̄ Formamid., gr. ¼.

The treatment by inunction has many advocates, especially on the Continent, and it is undoubtedly attended by very satisfactory results, especially when used in conjunction with hot sulphur water baths. One drachm of unguentum hydrargyri is the usual amount prescribed for each rubbing, and an ordinary course consists of from thirty to forty rubbings applied daily. It is necessary to vary the locality as much as possible, and the hairy regions of the body must be avoided, as the treatment may set up mercurial dermatitis. The ointment is usually applied at bedtime, remains on all night, and is washed off on the following morning. By means of the inunction treatment a patient may be rapidly put under the influence of mercury, whilst the alimentary tract is left available for the administration of other remedies should they be indicated; but there are many objections and contra-indications to the method; it is uncleanly and consequently repugnant to the feelings of the refined patient; it is irritating to the skin and so is inapplicable in the presence of vesicular and pustular syphilides; it is frequently productive of insomnia; it involves publicity either by the employment of a skilled rubber or from the stains left on the bed linen or under-garments;. it is further sometimes productive of a very intense form of salivation.

The treatment by **intravenous injections** is now seldom adopted, and it is hardly applicable as a routine plan, as it is often difficult, especially in women, to find a vein of sufficient size into which the needle might be introduced. The solutions usually made use of were cyanide or benzoate of mercury in 1 per cent. solution, the daily dose being from 15 to 20 minims introduced into the median basilic vein, and thirty to forty injections constituting an adequate course. The treatment is painless, reliable, rapid in its results, and in the experience of the writer perfectly safe.

Other plans of introducing mercury into the system, such as fumigations, inhalations and rectal administration, have been previously alluded to, but they are so seldom employed and are of such doubtful utility, as not to merit any detailed description.

Opinions as to **how long mercurial treatment should be employed** have of late years undergone significant modifications. Until comparatively recently, two years was considered sufficient for a cure, a doctrine equally pernicious and dangerous, and one which must be held responsible for the occurrence of numerous of the later manifestations, such as nerve and visceral syphilis. The tendency now is to prolong the treatment by intermittent courses of mercury extending over five or even seven years, and each course of mercury the patient submits to is an extra insurance against the occurrence of any manifestations of the disease in years to come.

The duration of the treatment will be to some extent influenced by the serum diagnosis of Wassermann, or by one of its modifications; a positive reaction is an indication for further treatment, though the absence of the reaction does not of necessity imply that the patient is cured. The reaction is abolished by efficient mercurial treatment, and for the test to be of any value at least three months should elapse since the termination of that treatment.

As an adjunct to the mercurial treatment, **Iodine** is often of the greatest value, and its administration is specially indicated either alone or in conjunction with mercury in the treatment of obstinate ulceration of the buccal or other mucous membranes, or to subdue the pain of syphilitic osteitis and periostitis. It may be administered in the form of iodide of potassium, of sodium or of ammonium, and its action is enhanced by dilution with half a pint of water, and by the addition of spirit. ammon. aromat. It may be given intramuscularly in the form of iodipin in doses of 8 drachms injected on alternate days for a month or six weeks. Other valuable modifications have also been introduced, such as iodalbin, sajodin, iodoglidin and iothion.

The value of **Arsenic** as an adjunct to mercury has long been recognised, and Donovan's solution, or liq. arsenii et hydrarg. iodid., has been utilised in the treatment of syphilis for certainly more than half a century. But the amount of arsenic than can be introduced into the system by way of the stomach is limited by the occurrence of toxic symptoms, and it is obvious that if the drug acts as an antagonist to the syphilitic virus, larger doses are requisite than could be administered orally. With the object of facilitating the introduction of larger quantities of arsenic into the system, modifications of that drug have been devised, which can be administered by the intramuscular method, and which avoid any irritation of the gastric mucous membrane. The most familiar of the aryl-arsonate group are atoxyl, containing 27·3 per cent. of arsenic; soamin, with a percentage of 22·8; arsacetin, 21·25 per cent., and orsudan, 25·4 per cent. Considerable success was met with by the employment of the latter drug, given intramuscularly in doses of 10 gr. introduced on alternate days, ten injections constituting a course, so that by this means at the end of nineteen days over 25 gr. of arsenic had been introduced into the system. The treatment by this as by other of the aryl-arsonates was found at first to be most satisfactory, and in a certain number of cases the disease appeared to be aborted in its early stages. But, more mature investigation proved that it was by no means universally successful in checking the progress of the disease, that relapses occurred shortly after the cessation of the treatment, and, as an insuperable objection, that it was sometimes followed by total and irremediable blindness, circumstances which have considerably damped the ardour of those who conceived that a remedy had at last been discovered for this most formidable of diseases. One of the earliest to recognise the possible value of arsenic in the treatment of syphilis was Professor Ehrlich, of Frankfort, who in the first place introduced arsacetin as an antisyphilitic remedy. Aware by subsequent experience of the dangers which attended this and others of the aryl-arsonate group, he pursued his investigations with a view of devising a remedy which would not only destroy the organisms in protozoal diseases, such as syphilis and trypanosomiasis, but which would, on the other hand, be exempt from the serious toxic symptoms which have hitherto proved an obstacle to the use of such preparations. As the result of his researches into the chemistry of arsenical compounds, he has recently evolved a preparation originally known as 606, in allusion to the fact that 605 different preparations of arsenic had previously been dealt with; it has since been named Salvarsan; the chemical title of the preparation is dioxy-diamido-arseno-benzol; by some of his enthusiastic admirers it has been denominated Ehrlich's specific for syphilis. It is claimed for this preparation that by one injection the symptoms of the disease in any of its stages may be brought under control with extraordinary rapidity, and that one dose may be sufficient to effect the destruction of all the spirochætes present in the individual, and so effect an immediate and complete cure. It has certain counterbalancing disadvantages, in that the injections from their bulk alone are liable to be followed by intense pain; the patient has to be confined to bed for at least a week; severe pyrexia may follow on the injection, and numerous relapses have been recorded; finally, it is not entirely free from danger, and at least twelve fatalities are attributed to it. For a healthy adult the dose is 8 gr.; to this is added 6 minims of a 20 per cent. solution of caustic soda, and subsequently about ʒiij of normal saline solution; the solution may be neutralised by the addition of a ½ per cent. alcoholic solution of phenolphthalein and glacial acetic acid until the mixture assumes a faint rose tint, indicating that it is very slightly alkaline. The whole amount may be injected deeply into the buttock or beneath the scapula, or half of it may be introduced on either side; it may also be administered intravenously. The following is *the technique of the intravenous injections*; the powder is dissolved in 100 cubic centimètres of warm distilled water to which 10 to 15 cubic centimetres of $\frac{N}{5}$ sodium hydrate solution is subsequently added, and the solution is made up to ʒviij with distilled water, and is slowly injected into the median basilic vein. The injection is shortly followed by rigors and vomiting, from which the patient completely recovers by the following day. Widely divergent opinions as to the merits of salvarsan have been expressed; it has been welcomed in Germany with the greatest enthusiasm, where it has been said that its discovery forms one of the greatest and happiest events in the history of the natural sciences, though its reception in France has been of a much cooler nature. In the experience of the writer, it is in efficiency considerably in advance of the aryl-arsonates previously alluded to, and is a valuable acquisition to our stock of antisyphilitic remedies; but it has such limitations, disadvantages and dangers that it does not appear likely at present to depose mercury from its position of therapeutic supremacy.

Another arsenical compound which has been highly recommended is **Hectine**, the solutions of which are painless, very slightly toxic, and productive of no evil effects on the organs of vision. It is administered as a 10 per cent. aqueous solution, 17 min. of which may be injected on alternate days for a month or six weeks; it may also be given in conjunction with the soluble mercurial salts.

As an adjunct to treatment on the above lines, **Sarsaparilla** must be mentioned, since it appears to render the patient more tolerant of treatment by the iodides, and if given with mercury to somewhat enhance the action of that drug. It may be given in the form of the extract. sarsæ liquidum, or may be added to one of the mixtures of mercury or the iodides previously alluded to. It enters largely into the "Zittmann" treatment, which consists in the daily administration of 2 pints of a strong decoction of sarsaparilla to which is added sugar, alum, calomel, cinnabar, anise, fennel, senna and liquorice; also, the same quantity daily of a weak decoction made from the dregs of the above, with the addition of lemon peel, cardamon seeds and cinnamon. The patient is confined to a room kept at the temperature of 80° F., and is kept on a light diet; the course lasts for from three to six weeks, and consists in purging, sweating, low diet and rest. It is usually given as a last resort in cases of tertiary syphilis which have hitherto resisted all other forms of treatment, and occasionally it meets with success.

The following prescriptions may be found useful in certain manifestations of the disease:

For condylomata, rhagades and mucous tubercles: ℞. Calomelanos, Zinci Oxidi, Amyli., āā ad ʒjss; ft. pulv., sæpe utend.

For ulceration of the throat, tongue or buccal mucous membranes: ℞. Hydrarg. Perchlor., gr. 2; Acid. Nit. Mur. Dil., ℥ss; Syrupi Aurantii, ℥j; Aq., ad ℥viij [U.S.P. ℞. Hydrarg. Chlor. Corrosiv., gr. 2; Acid Nitrohydrochloric. Dil. ℥ss; Syrupi Aurantii, ℥j.; Aq., ad ℥viij.]; ft. gargarisma; sæpe utend; or, as a topical application the following solution may be painted on any ulcerated surface two or three times a day: ℞. Hydrarg. Perchlor., gr. 4; Acid. Nit. Mur. Dil., ♏10; Glycerini, ʒj; Aq. Rosæ, ad ℥j [U.S.P. ℞. Hydrarg. Chlorid. Corrosiv., gr. 4; Acid Nitrohydrochloric. Dil., ♏10; Glycerini, ʒj; Aq. Rosæ, ad ℥j]; ft. pigmentum.

For syphilitic alopecia: ℞. Liq. Ammoniæ, Tr. Cantharidis, Glycerini, āā ℥ss; Aq. Rosæ, ad ℥iij; ft. lotio; nocte maneque utend.

For mercurial stomatitis: ℞. Potass. Chlorat., gr. 15; Acid. Nit. Mur. Dil., ♏10; Syrup. Aurantii, ʒj; Aq. Camph., ad ℥j [U.S.P. ℞. Potass. Chlorat., gr. 15; Acid. Nitrohydrochloric. Dil., ♏10; Syrup. Aurantii, ʒj; Aq. Camph. ʒij; Aquam ad ℥j]; ft. mist; ℥j t.d.s.

Mouth wash for mercurial stomatitis: ℞. Tr. Myrrhæ, Tr. Krameriæ, Tr. Cinchonæ, Tr. Catechu, āā ℥ss; Eau de Cologne, ℥j ʒj; ad Aq. ℥ij [U.S.P. ℞. Tr. Myrrhæ, Tr. Krameriæ, āā ℥ss; Tr. Cinchonæ, ʒv ♏20; Tr. Gambir. Co., ℥ij; Eau de Cologne, ℥j ʒj; ad Aq. ℥ij]; ut collutorium utend.

Astringent paint for gums in gingivitis: ℞. Cupri Sulphatis, gr. 20; Aquam, ℥j; ter die applicand.

For obstinate ulceration of the tongue: ℞. Pil. Hydrarg., gr. 1; Iodoform, gr. ¼ [U.S.P. ℞. Massa Hydrarg., gr. 1; Iodoform, gr. ¼]; ft. pil.; t.d.s. post cib.

Application to syphilitic ulcers: ℞. Iodoform, Calomelanos, āā ʒss; Ol. Olivæ Opt., ʒij; Ol. Rosmarini, ♏10; Lanolin, ad ℥j; ft. unguent.

For palmar or plantar psoriasis: ℞. Hydrargyri Oleatum, 5, 10 vel 20 per cent.; hora somni applicand.

J. ERNEST LANE.

THE CLINICAL PATHOLOGY OF SYPHILIS IN RELATION TO TREATMENT.

UNTIL Schaudinn's discovery, in 1905, the specific organism of syphilis had not been isolated and the diagnosis of infection rested solely on clinical grounds, and in the absence of clinical manifestations no certain diagnosis could be made. The length of treatment necessary in any given case, or the time when any person could be told that he was cured, could only be judged by rough rule-of-thumb methods, and it is certain that many persons were placed on long-continued mercurial treatment who never had the disease, and that many so-called "cured" cases had relapses or became the parents of syphilitic offspring.

Now, however, infection can be diagnosed with certainty in the very early stages by means of dark ground illumination with the reflecting immersion condenser (ultra microscope), or in the later stages, whether the disease be active or latent, by means of the serum diagnosis (Wassermann reaction). By the help of the ultra microscope, the treponema pallidum can, if local antiseptics have not been used, be detected easily in scrapings from the site of the inoculation, even before any definite chancre has developed. Its appearance is that of an extremely fine, sluggishly motile silvery spiral, with very regular and closely set spirals. Much valuable time is thus gained and the patient is saved the discomfort of the secondary manifestations. Neisser has shown by means of the Wassermann reaction that the earlier that anti-syphilitic treatment is commenced the more probability is there that early and permanent cure will result; therefore the ultra microscope, which settles at once whether the commencing pimple or ulcer is the site of a syphilitic inoculation or not, must be considered of the greatest possible value from the point of view of treatment.

By the help of the ultra microscope, the treponema can also be detected in scrapings of a papule or mucous plaque; but it is to the phenomenon of the development of a substance in the serum of syphilitics that has the property of combining with another substance present in organ extracts, and in this process of combination using up complement (a substance present in all fresh blood), that we chiefly depend for the diagnosis of late or latent syphilis, for the determination of the progress made under treatment, and for determining the time when cure has been effected.

This complement fixing test first worked out by Wassermann, and which carries his name, necessitates a somewhat elaborate and complicated technique, and many observers have tried to simplify the method. These methods (Hecht, Bauer, Fleming, Stern, D'Est Emery) are "simplified" by substituting variants for constants, and practically all pathologists with any extensive experience of this reaction seem to agree that in a comparative test such as this, all factors except the one to be tested should be constant. The general opinion is therefore strongly in favour of Wassermann's original technique, compared with any of the simplified methods. Another great advantage of the original technique is that a quantitative measurement of the complement fixing substance can be obtained, which is not possible with the simplified techniques. As the patient gets under the influence of treatment less and less complement will be fixed, and frequently after a three months' course of mercurial inunctions or intramuscular injections no more complement will be fixed than with a normal serum. This does not, however, mean that cure has been arrived at, for if all treatment is left off a positive reaction will recur after a few weeks or months' interval. A solitary negative reaction, therefore, obtained with the serum of a patient undergoing treatment, means little beyond the fact that the patient is reacting to the treatment.

A *series* of negative results, obtained at intervals of three months after all treatment has been given up, is necessary before the patient can be told that he is cured. It is important to remember that from 10 to 15 per cent. of untreated cases of syphilis fail to give a positive reaction at the first examination, and that therefore a single negative reaction only gives a 90 per cent. probability of freedom from infection.

If after several months' treatment the reaction still remains strongly positive and large doses of complement are still fixed it is an indication that the treatment is inefficient and more vigorous methods should be adopted.

If, however, after each course of treatment, a smaller amount of complement is fixed or the intervals before a positive reaction returns become longer and longer, we may conclude that the treatment is satisfactory and that there is no necessity to increase the dose.

If we can judge the efficacy of treatment by the period of time elapsing between the commencement of the treatment and the onset of some clear effect of treatment as shown by the Wassermann reaction, it would appear that the new Ehrlich-Hata preparation, "606" (dioxy-diamido-arseno-benzol), is the most efficient; a negative reaction occurring in the majority of cases in from a month to six weeks.

As regards the various methods of giving mercury, inunction and intramuscular injection of insoluble compounds both produce an effect in the majority of cases in three months, whereas pill treatment or suppositories usually show no effect for at least six months. A positive reaction is frequently obtained after pill treatment of two years or more, and on pathological grounds, therefore, this mode of treatment cannot be recommended.

My own investigations on this subject point to the conclusion that inunction is the most efficacious form of mercurial treatment, and that intramuscular injections of calomel come next in order of potency.[1]

Whereas 90 per cent. of untreated cases of syphilis give a positive reaction, only about 80 per cent. react positively after one course of mercurial injections, gradually and progressively diminishing to 35 per cent. of positive results after six courses (two years). Although still remaining positive 69 per cent. show some effect of treatment after only three months (Harrison).

A few remain positive after three or four years' treatment, and it is therefore obvious that no fixed time for treatment can be laid down. Three years, however, seems to be the shortest period that can be advised with any safety, and this of course must be prolonged if the Wassermann reaction is, or becomes, positive.

For the differential diagnosis of gummata from tubercular or malignant disease, for the diagnosis of latent congenital or acquired syphilis, or as a means of determining whether a patient may marry, or as a means of controlling treatment, the Wassermann reaction is indispensable.

The original technique necessitates the use of more blood than can conveniently be obtained from a finger prick, and the sample is usually taken by venipuncture of the most prominent vein at the bend of the elbow, the site of the puncture being cleaned with ether and then absolute alcohol. A syringe or my own simple venipuncture apparatus[2] can be used, after sterilisation by boiling. The latter is the more convenient and rapid if numerous samples have to be collected at one visit. The needle should have the calibre of an exploring needle and not be more than 1½ inches long. Five to ten centimètres of blood are collected into a stout sterilised glass tube. The sample is then closed with a rubber cork, and can be safely sent through the post.

With infants and small children, or adults when a vein cannot be seen, a few drops of blood are collected from the ear or finger into a drawn-out glass tube, in the same way as for a Widal or opsonic test. In these cases the original technique has to be modified and capillary tubes and a technique similar to that used for opsonic estimations, substituted for test tubes and pipette measurements.

The larger amount of blood is to be preferred, but quite reliable results can be obtained with the smaller quantity. With small infants blood can usually be obtained most easily by pricking the ball of the great toe and squeezing out the blood.

H. WANSEY BAYLY.

REFERENCES.

[1] See Quarterly Journal of Medicine, Oxford, 1911, IV., pp. 232—4.
Lancet, 1909, I., p. 1248.

TETANUS.

Tetanus occurs under natural conditions in man and the lower animals. The disease is due to the bacillus tetani first isolated by Kitasato from earth and from infected pus. The organism is also found in manure.

Means of Infection.—The portal of entry for the bacillus may be constituted by any lesion of the external integument, and infection may also occur through some abrasion so small as entirely to escape observation. The organism multiplies locally and its toxin diffuses rapidly, ultimately finding its way to the central nervous system through the axis cylinders of the peripheral motor nerves. In man the bacilli never enter the blood stream.

Incubation Period.—This varies in accordance with the virulence and amount of toxin inoculated. The longer the period of incubation the slower and more favourable is the course of the disease. In man the incubation period varies from two to fourteen days, and it is said with some truth that if this period proves to be less than eight days the disease will probably have a fatal termination, no matter what form of treatment is adopted.

Methods of Examination.—It is difficult to determine the presence of the bacillus in pus. Smears of the wound pus should be made, stained with diluted carbol-fuchsine, and examined microscopically for the presence of the drumstick-like bacilli. Cultivation and inoculation experiments can only be performed by a competent bacteriologist who is licensed to undertake vivisection experiments.

Local Treatment of Wound.—This is of little avail, save as regards the invasion of the wound by pyogenic cocci. No amount of local attention in the shape of antiseptic lotions and dressings will destroy the tetanus bacilli, which, in the normal course of events, rapidly produce their toxin and die out; hence, when once the symptoms of the disease have manifested themselves, amputation and other severe measures are of no service. For this reason the usual cleaning, swabbing and draining of the wound is all that is required.

Serum Therapy.—The use of tetanus antitoxic serum[1] we owe to Behring and Kitasato. It should be injected subcutaneously at the *earliest possible* opportunity under the skin of the abdomen or flank; 50 c.c. should be administered as the first dose, followed by 100 c.c. twenty-four hours later. This is best accomplished by splitting up the doses into quantities of 20 or 25 c.c. each and injecting these into different parts of the body. An alternative plan is to give two initial subcutaneous doses of 25 c.c. into each flank, and then a further dose of 25 c.c. intravenously into the median basilic vein. This intravenous injection should be repeated at intervals of forty-eight hours. The serum has also been inoculated in severe cases (as suggested by Semple and others) into the frontal lobes of the brain, employing a specially devised blunt-pointed needle inserted through a small trephine hole into the brain substance. The results obtained hitherto do not show that this method has any advantage over the preceding one. The doses above mentioned indicate the minimum amount of serum to be given, but there is no reason whatever why they should not be largely increased, employing a serum of as high a potency as can be obtained. Cases of established tetanus do not, as a rule, benefit to any marked degree by the use of anti-tetanic serum, on account of the treatment being applied too late.

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[1] The serum may be obtained in England from the Lister Institute, Chelsea Embankment (Tel. 754 Westminster), or from Burroughs & Wellcome, Snow Hill, E.C. (13300 Cent.). Full directions are enclosed with each phial. The serum should always be kept in the dark stored in ice, and be as fresh as possible.

Medicinal Treatment.—For obvious reasons medicinal treatment is difficult to carry out, especially when the "lock-jaw" is extreme. Administration of food must always take precedence of drugs, hence rectal injections of food supplemented by nasal catheterisation are often necessary.

Careful isolation of the patient and protection from all noise and light is essential. Many drugs, mostly of the sedative order, have been suggested, but their use is rarely beneficial. If the spasms are very severe chloral hydrate and bromide of potassium are of service, though in the opinion of many it is better to attempt to keep the patient under the influence of chloroform. This procedure is not unattended by risk, especially if the patient is the subject of heart, liver or kidney trouble. It is more prudent perhaps to attempt to keep the patient quiet by the hypodermic administration of morphia. This procedure is often of distinct service in severe cases.

Prophylactic Treatment with Anti-tetanic Serum.—Quite apart from and independent of the usual surgical measures adopted for lacerated and contused wounds when contaminated with dirt, dust or other foreign particles, it is the practice of the writer to administer a prophylactic dose of 25 c.c. of anti-tetanic serum subcutaneously into the flank on all occasions in which wounds have been contaminated with earth, manure, dust, etc., and to repeat the dose on three occasions at forty-eight-hour intervals. The erythematous and other rashes, together with the joint pains which may arise from four days to five weeks after these doses, may be entirely neglected.

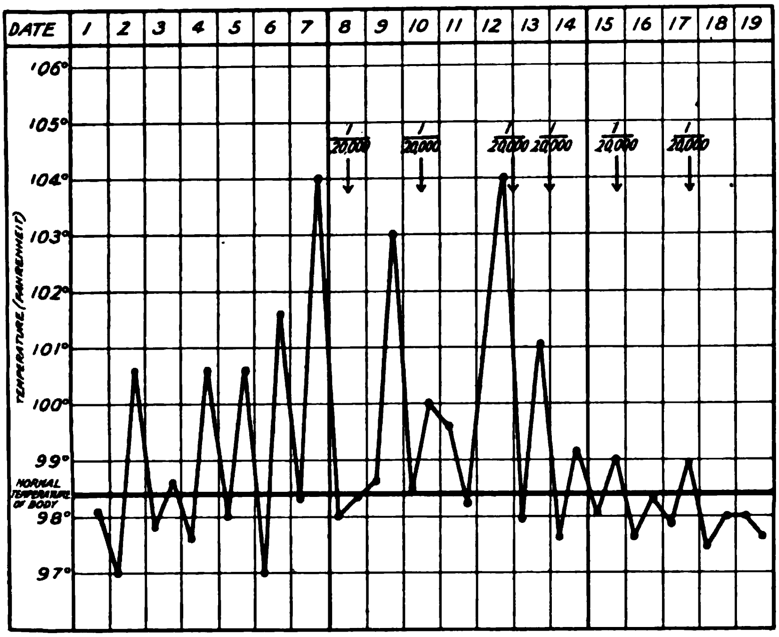
HAROLD SPITTA.

TUBERCULOSIS (ACUTE).

ACUTE TUBERCULOSIS may affect the lungs, or any other organ. The treatment of this form is dealt with in the articles in the respective sections, viz., pulmonary tuberculosis, meningitis, etc. In addition we meet with two other forms of acute tuberculosis, (*a*) miliary or generalised tuberculosis, in which all portions of the body are or may be affected, (*b*) acute tuberculosis without localising symptoms.

Miliary or Generalised Tuberculosis.—In this form treatment must necessarily be entirely symptomatic. Death always results, and treatment, whether with tuberculin or other substances has not hitherto been of any value.

Acute Tuberculosis without Localising Symptoms.—Occasional cases are met with in which there is profound toxæmia due to the invasion of tubercle bacilli, but in which no definite evidence is forthcoming as to the exact seat of the lesion. The diagnosis in such cases rests partly on clinical probabilities and partly on laboratory investigations. In all cases the prognosis is grave, but of recent years a much larger proportion of recoveries have taken place than formerly. Treatment should be carried out on the lines laid down for the treatment of acute pulmonary tuberculosis (*see* special article). Rigid and *absolute rest* in bed must be prescribed in order to limit auto-inoculation as much as possible. The patient should be bathed in *fresh air* continuously. As the patient usually suffers from more or less complete anorexia the *diet* at first should be limited to easily digested food such as peptonised milk. As the condition improves the diet should be increased in quantity and varied in substance until an ordinary full diet is taken. *Medicinal treatment* and the administration of *stimulants* must depend upon the varying symptoms of the patient. Some patients recover on this symptomatic treatment alone, but in the majority of instances the question of recovery is determined in large part upon the patient's capacity to react to the administration of *tuberculin*. The principles governing the administration of this vaccine are dealt with in the special article on Tuberculin Therapy in Vol. III. It is sufficient to say here that in these acute cases it is best to commence with a minimal dose such as $\frac{1}{500000}$ mg. (·0000002 c.c.) T.R. If the temperature is raised after such a dose we must wait a few days before repeating it, and according to the degree of the disturbance will have to decide whether to give the same dose or an even smaller one. If no effect is produced by the initial dose, $\frac{1}{400000}$ mg. may be given 24—48 hours later. If the initial dose is followed by a lowering of the temperature, a slightly larger dose should be given as soon as the symptoms, and especially the temperature record, show that the effect of the dose has worn off. A good example of the value of tuberculin in these acute cases is shown in the accompanying chart. It will be noticed that in this case the administration was by the mouth, and that a larger initial dose was chosen, viz., $\frac{1}{20000}$ mg. T.R. than those suggested above. My subsequent experience has led me to give smaller doses, in order to determine the sensibility of the individual patient to tuberculin. If the patient is tolerant to its action the doses of the vaccine may be rapidly increased; if, however, he is intolerant, the use of minimal doses does away with the chance of doing appreciable harm.



Case of Acute Tuberculosis without localising signs.

The patient, a man, was taken suddenly ill with high fever and rigors. Four days subsequently he was admitted to St. George's Hospital. He was emaciated, semi-comatose and had occasional rigors. Absolute rest was tried for a week without effect. As the clinical symptoms suggested a diagnosis of acute tuberculosis the opsonic index for this infection was taken on the seventh day. When the temperature was normal the index was 1·75, and when the temperature was 104° F. the index was 0·73. $\frac{1}{20000}$ mg. of tuberculin was administered by the mouth in the early morning of the eighth day. The temperature fell, and did not rise again for thirty-six hours. A further dose of tuberculin of the same size was given, and a similar effect produced. It was argued that tuberculin had a definite effect, but that as the effect of the dose wore off quickly, it would be advisable to give the dose at shorter intervals, viz., twenty-four instead of forty-eight hours. This was done, and the temperature fell to normal. The doses of tuberculin were gradually increased, and given at longer intervals. The patient recovered, and gained two stone in the hospital. He was reported to be well and at work two years after treatment.

The *after-treatment* of cases which improve under the above measures is precisely similar to that described in the article on the Sanatorium Treatment of Pulmonary Tuberculosis.

ARTHUR LATHAM.

TYPHOID FEVER.

ENTERIC FEVER.

The treatment of this disease is one of defence, and unfortunately not one of attack. Success, therefore, can only be attained by attention to the most minute detail, to careful instructions given to the nurses, to the regulation of the diet, and to the intelligent interpretation of the symptoms and complications that arise during the attack.

The physician cannot see his patient too often; when it is the question of an important life he must be continuously present, lest the armour of his defence be penetrated at any moment. Good nursing and careful hygienic management of the patient are more essential than a multitude of drugs. It is only recently that we have arrived at a true conception of the disease, following on the discovery of the fact that during the incubation period the bacillus appears in the blood. This fever is, therefore, a primary infection of the blood by the bacillus typhosus through the alimentary canal —a bacillæmia with secondary involvement of the intestine, Peyer's patches, the solitary follicles, the mesenteric glands, the spleen, the liver, bile ducts, and gall bladder. On this hepatic invasion considerable stress must be laid, as it points the way to the *rationale* of treatment by the use of certain drugs. Enteric fever is often a complex clinical syndrome, in which a mixed infection of typhosus and paratyphosus is present, and to these may be added the secondary infections of staphylococci or streptococci, appearing either locally as an abscess or generally in the blood. A case here and there of this disease is often a tangle of infections, which will require all the combined skill of the physician and bacteriologist to unravel. For a long time the case-mortality in many institutions has been reduced to under 10 per cent., many claiming by hydrotheraphy even lower figures than that. It is, however, clear that we cannot expect such brilliant results in the East; the disease in tropical countries is of a severe type, the duration is longer, complications and sequelæ more often seen. The case-mortality in the British Army in India during recent years has varied from 30 per cent. to 17 per cent.; the figures speak for themselves, as an index of the case severity. Typhoid fever has long been the scourge of the British Army in India. Army medical officers have, therefore, gained considerable experience in its treatment, the hospitals are well equipped for the reception of these cases, and the nursing staff is well organised. The combination in military hospitals is that of doctor, nurse, bacteriologist and sanitarian dealing with all outbreaks, cultures are made from the blood and dejecta; Widal's reaction is used to differentiate between typhoid and the paratyphoids. In causing outbreaks milk and water now play a small part, for in barrack life it has been possible to ensure their practical non-contamination; but the human factor—contact with a person harbouring typhoid bacilli, whether in the initial stage of the disease, or as a convalescent, or as a "chronic carrier"—is the greatest source of danger to a body of men. The isolation of men in the same tent, barrack, or in the ward of a public institution, who have been in contact with a case of developing typhoid fever, is necessary when dealing with an outbreak. In the investigations in Southern Germany by Koch, Convadi and others, it was shown that it is the contacts who perpetuate a dropping fire of cases when the main epidemic has subsided, and when the supplies of contaminated water, milk, etc., have been stopped. The part played by *flies and dust* in the East is important. Faichnie has shown that it is not the ordinary fly in its daily scavenging excursions that is the propagator; but the fly bred in the trenches from typhoid dejecta. This becomes a true "carrier," passing bacillus typhosus in its excreta for the best part of its life. Dust has been likewise blamed as carrying the infection; but it goes against our general experience of pathogenetic bacteria that they should be able to survive this drying and oxidising process. Morgan and Harvey have proved that the bacillus typhosus has not the surviving power it has been credited with, and that in contact with air, or air and sunshine, or with water or saprophytes it soon dies out. They have proved that the experiments of Firth and Horrocks made in 1902 with cultures of the bacillus were misleading. Here it may be mentioned that there is no such disease as *typho-malaria* in the East as a separate and distinct entity. In malarial countries numbers of the cases of typhoid fever show malarial parasites in the blood when first examined; they are probably a recrudescence of malaria previously contracted and awakened by the typhoid attack. The two diseases can, therefore, exist together, but they are an accidental combination.

The origin of outbreaks.—An outbreak in institutions, such as schools, orphanages, asylums, infirmaries, etc., demands an investigation tracing the introduction to its source. This may, of course, be the same as that of an epidemic outside their walls originating from milk, water, shell-fish, etc., but if no such origin exists, then search must be made among the inmates themselves. Either it arises from some person recently admitted who has just recovered from an attack of typhoid fever, or an ill-defined illness with gastro-intestinal symptoms, or from a nurse who has come from a typhoid case; failing these an examination of the staff must be made, especially that of the kitchen staff, with a view of discovering a chronic typhoid carrier among them. The history of illness of each one must be taken, and any put aside to whom suspicion is directed by their medical history. A capsule of blood is taken from the finger of each and sent off to a laboratory for Widal's test. The discovery of a typhoid carrier by means of Widal's test is not a certainty, but the majority of these do show the agglutination reaction. If this fails, circumstances may point to the likelihood of a certain individual being the origin of the outbreak; it is then necessary to obtain from a laboratory tubes for the collection of a small quantity of urine and fæces, for examination by the bacteriologist. The chronic typhoid carrier, as a rule, passes bacilli typhosus in the stools from time to time with intervals of freedom, whereas the convalescent will probably pass these in the urine as well. Should an examination of the urine fail to find the bacilli, no further test in this fluid need be made, but small portions of fæces require to be sent from time to time to the laboratory. If mucus is seen in the stool, it is preferable to collect from this rather than from the mass. A case of typhoid fever occurring in a private house may show a connection with a general outbreak, such as that of a typhoid carrier infecting a milk supply.

It is, however, necessary to investigate the medical history of the family and domestics, and to keep in mind the possibility of a typhoid carrier being present. The majority of carriers, it is to be remembered, are women, and it may be accepted that a case of typhoid bacilluria is more dangerous than one passing bacilli in the stools, as in the former case the hands are more likely to become contaminated. With the improvement of sanitation and water supply in Europe, the incidence of typhoid fever is diminishing, and certainly that of water-borne epidemics. Cases of persons travelling on the Continent and returning to England to develop this disease are less frequently seen than formerly. It is necessary to warn those projecting tours in the East—to Turkey, Egypt, India, etc., that certain precautions must be taken. These are to avoid taking unboiled milk, butter, jellies or salads during their journeys, and preferably to limit themselves to the hot dishes of a menu, and also to supply themselves with soda-water. In India typhoid fever was a menace to winter tourists, and is still to some extent; but improvements have taken place in the milk and butter supplies from modernised dairies, and in the quality of soda-water found in the refreshment-rooms. When travelling in out-of-the-way places in the East it is necessary to boil the drinking water. In military life this is done on a large scale, but more stress is now laid on the necessity of preventing camps and their vicinity becoming fouled than was formerly the case. Experience in the South African war proved the danger of dirty camping grounds. The narrow straddle-trench has been adopted as more easily filled and cleaned than the broad trenches whose sides were always seriously befouled.

HYGIENE AND MANAGEMENT OF THE PATIENT AND HOUSEHOLD.

A practitioner taking over charge of a case of typhoid fever has necessarily a certain amount of prophylaxis to carry out. He should be cognisant with the above main facts when making the necessary domestic dispositions. Cases of typhoid fever are better dealt with in towns by removal to a hospital or a nursing home, thereby removing the danger from other inmates of the household. In private houses, the selection of a large and airy room is called for. All furniture, carpets, pictures and hangings must be removed, and the place swept clean. In winter heating should be arranged for, so that the room temperature does not fall below 65° F. In hot climates it will be found necessary to cool the room by contrivances usually in use, the electric fan or the punkah, a thermantidote or grass screen kept moist by water in the dry and hot season. The bed must be a cot of moderate width, preferably 3 feet broad, and placed in the centre of the room to facilitate nursing. The mattress should be a flat, hair one, and if too hard, covered by two folded blankets, over which there should be a mackintosh sheet, the white linen or cotton draw-sheet being laid over all. Two such beds of the same height are a convenience, as the patient can be moved from one to the other. Such beds and mattresses are to be hired if not available in the household. The patient is to be confined to bed as early as possible, and not to be moved where there is a suspicion of typhoid fever. It is important to advise against any move or journey, even though it may mean a better climate or situation that a patient can be transported to. The risk is too great; many disastrous examples of this have occurred, and the responsibility and blame are placed on the medical man. Two nurses are a necessity, one for night and one for day work, and in a case complicated by violent delirium a third is required. In the employment of disinfectants there is considerable choice, the preparations of phenol being those in more general use, such as creosol, lysol, cyllin, phenyle, zotal, etc., the disadvantage being the odour that pervades the ward or house. The same may be said of chlorinated lime. To meet this, mercury salts can be used for the sick room, but are counter-indicated in the disinfection of linen, towels, etc., for which a carbolic-acid solution (1 in 20) is the best. In these the linen is to be soaked before being given out for washing. Perchloride of mercury for the disinfection of stools can be prescribed as follows : ℞. Hydrarg. Perchlor., 1 oz.; Ammon. Chlor., 3 oz.; Aq. Dest., 1 pint [U.S.P. ℞. Hydrarg. Chlor. Corrosiv., 1 oz.; Ammon. Chlor., 3 oz.; Aq. Dest., ℥20]. One volume of this to 100 of water makes a solution of 1 in 2,000; for stools it requires to be 1 in 1,000. The nurse should be instructed to dilute the solution with half the amount of water for this purpose, and likewise for washing bed-pans, urinals, and mixing with the urine. With our present knowledge of the means by which the bacillus is carried to contaminate the food of other persons, it stands to reason that strenuous efforts must be made to keep the hands of attendant nurses disinfected. The hands are a grave source of danger to themselves and others, hence there must be arranged in the sick-room a basin, soap and nail-brush for cleansing the nurses' hands, with a bowl of antiseptic in which they can be rinsed. The perchloride of mercury solution and carbolic acid lotion are in the long run very trying to the skin; a less injurious preparation is either lysol or bin-iodide of mercury, prescribed as follows: ℞. Hydrarg. Perchlor., 1 oz.; Pot. Iodidi, 3 oz. Aq. Dest. 1 pint [U.S.P. ℞. Hydrarg. Chlor. Corrosiv., 1 oz.; Potass. Iodidi, 3 oz.; Aq. Dest., ℥20]. Sig.: Dilute 1 in 100 of water for a solution of 1 in 2,000. The dishes, spoons, etc., used in the sick-room must be washed there and dried by separate dish-cloths, and never brought into the general use of the household.

During the course of the illness it is important to keep the patient scrupulously clean; when the treatment consists of sponging, bathing, etc., it effects this desideratum, but in addition it is necessary to keep the skin free from the heavy odour characteristic of the disease, and free from the stale smell of perspiration. It is important to preserve the nates and sacrum from bed-sores. An excellent plan is to have a liberal supply of finely-powdered boric acid at hand, to keep the trunk, armpits, back, and folds of the skin well powdered with this, and, moreover, to rub it into the roots of the hair. This treatment has the effect of preventing the hair falling out, as it is apt to do after so prolonged an illness, and will gain the gratitude of lady sufferers. Patients treated like this are less liable to develop furunculosis as a sequela. As the urine is likely to contain bacilli, the pudenda are with advantage treated with boric powder and any redundance of hair removed. The efficiency of the nursing is assisted by having a number of necessary articles in the sick-room; in the selection of these the following list will prove useful:

Bed-pan.
Enema.
Urinal.
Bucket with carbolic solution for soiled linen.
Feeding cups and spoons.
Tumbler and cup and saucer.
Ice-pail.
Earthenware or enamelled iron bowls: four at least, for solution, for nurse's hands, for ice, for icing jellies, etc.
Two basins (one for nurses).
Two soap dishes.
Two cakes of Sunlight or antiseptic soap.
Jugs for milk, etc.
Absorbent wool, 2 lb.
Carbolised tow, 4 lb., for receiving motions if passed involuntarily.
Bottles for disinfecting solutions.
Mackintosh sheet.
Rectal tube.
Catheter.
Thermometers, bath and clinical.
Temperature charts.
Notebook.
Towels.
Napkins.
Ice-bag.
Scissors.

DIET.

The profound disturbance of the intestinal tract and digestive organs which takes place in this fever, together with the fact that the struggle for mastery is prolonged, makes the problem of diet a difficult one. It means, on the one hand, the prevention of feeding with any but liquid and very easily assimilable articles, and, on the other, supporting the patient's strength in anticipation of the profound exhaustion seen in the later stage. The general consensus of opinion and practice is in favour of an entirely liquid diet, such as milk and beef-tea; but from time to time advocates of a more liberal diet have published their experiments, such as Kinnicutt, Shattuck, Wilson, Marsdon, Fitz, Moorhouse and Busnuyev. The diets of these authorities vary from a mixed soft one with soup to one with chicken and cutlets. The mild cases of enteric are proof against any error of dietetics, and should be excluded when arriving at conclusions. There are few of us bold enough in severe and prolonged cases to order a liberal diet. A great deal of judgment is required in each and every case. What is suitable to a case with no abdominal symptoms is scarcely to be prescribed for one with tympanites and diarrhœa. In the first week of the disease it is better to under-feed, as there is often considerable gastric derangement, headache and a disinclination for food, and if much be forced on the patient it merely lies undigested in the intestines. Rather the patient should be persuaded to drink large quantities of water, preferably cooled by ice. Altogether it is better to err on the side of caution, and at least to respect what has been the universal custom for generations of medical men, viz., giving a liquid and restricted diet. Whitla lays down a rule to forbid every form of food except such as would readily pass through the meshes of the fine sieve. Even then it is possible to over-feed the patient and to fill the intestines with food that they cannot deal with.

Milk.—A more or less exclusive milk diet has been the general rule, and is suitable for most cases, the quantity given being 3 or 4 pints in the twenty-four hours. A wineglassful every hour is a good rule, provided that the patient is not disturbed by feeding, especially at night, and that some is given in the early morning when the vital processes are low. The milk can be given with the addition of liq. pancreaticus, or zymine powders (5 gr. to each cupful of warmed milk, and digested for fifteen minutes). The milk can be warmed or iced, and it is the rule especially in the East to have it boiled first. Citrate of soda (15 gr. to 1 pint) can be added in order to make the curd deposited by the gastric juice finer. Soda-water (except in tympanites) can be used to dilute the milk, and is a pleasant way of administering water and food together, especially as large quantities of liquid are required. *The indication that milk is not agreeing is the passage of undigested curds in the stools or the existence of constipation.* In the former case peptonising, or replacement by whey, is indicated; in the latter the addition of beef-tea, mutton broth, chicken broth, or any meat extract will generally overcome the constipation.

Whey.—One has seen in the post-mortem examinations of patients who have died of typhoid fever, and been fed on a more or less exclusive milk diet, very considerable masses of curds lying in the lower part of the intestine. That these should irritate the ulcers and become a source of danger is a conclusion easily arrived at. It leads us to understand that there has grown up a number of practitioners who prefer to prepare whey from milk for administration to typhoid patients. It has the support of authorities like Jenner, Burney-Yeo, Gee and Ewart, and has become a very widespread practice: 3 to 4 pints of whey are administered in the twenty-four hours. This can be prepared with rennet, but it is as well to remember that rennet manufactured from a calf's stomach does not curdle boiled milk. It should be added to unboiled milk, and the whey boiled subsequently for sterilising. The curd is wrung out in fine muslin to separate the whey. Another method is to add lemon- or lime-juice to milk; this curdles the casein, and the whey can be separated as above. For small quantities it can be separated by sherry or an acid white wine.

Albumin-water has been recommended by Sir William Osler. It is prepared from the whites of eggs, shaken up with ice and a little water and strained. This can be flavoured with lemon, sherry or brandy. It is especially useful in cases of extreme toxæmia when the abdominal condition excludes the use of milk, or when there has been hæmorrhage.

Meat Broths, Soups and Jellies and Meat Extracts, etc.—These may be added to the milk or whey diet in ordinary cases with no abdominal complications; but it is necessary to watch the effect of their administration on the temperature and on the number of motions per day, lest diarrhœa be set up. On the whole, they add a pleasant variety to the monotony of the milk or whey diet. Protein nourishment, such as plasmon and somatose, are a reserve to be kept back or advanced with a certain amount of discretion. Raw beef juice acidulated with a little dilute hydrochloric acid is another preparation to be given in sparing quantities. In the East it is counter-indicated, as patients, having had this for dysentery or typhoid fever, often recover to find themselves the victims of tapeworm. It can, however, be heated just to the boiling point to destroy the embryos of this parasite.

Carbohydrates.—Most authorities are of opinion that these should be withheld or only given sparingly. This has been our experience in the severe cases in India. Benger's food, made with milk and given twice a day (one teacupful), is a useful change, provided a watch is kept on the temperature to see if any change for the worse takes place. The continued use of milk and the small amount of carbohydrate in this diet has given rise to the suggestion by Duncan to reinforce these by lactose, glucose, maltose, sugar and honey. Sugar merely for the use of sweetening tea and milk is certainly beneficial if desired by the patient. Arrowroot and milk in sparing quantities is also recommended; but it is better to do away with any of the carbohydrates when there is marked tympanites, as they are apt to make matters worse.

Fats are not digested during typhoid fever, even the quantity in milk sometimes proves too much, necessitating a skimming of the milk. The fatty matter in the yolk of eggs is of some use, but a controversy still exists regarding the employment of eggs in the diet, as giving rise to intestinal fermentation and irritation. To exclude them entirely means giving up valuable assistance in maintaining the nutrition of the patient. The best form of administration is that of liquid custard, flavoured with vanilla and a little sugar, or as egg-flip, but a cooked preparation is preferable to a raw one.

Salt.—There is a diminution in the amount of chlorides excreted in this fever, but the total amount is increased when polyuria exists (Sollmann and Hoffmann). Patients on milk diet only certainly experience a "salt-hunger," and to meet this Todd uses saline beverages of sodium chloride, 10 gr., potassium bicarbonate, 5 gr., in 8 oz. of water; a little lemon-juice added at the time of drinking causes a mild effervescence. In any case, it is as well to give a little salt in any beef-tea or broth preparations, as it is a necessary addition to the diet.

Water.—The imbibition of large quantities of water is by many considered an important part of the treatment: 4 to 6 pints or more daily are advocated. The ingestion of so much is considered so valuable that it must be forced on the patient. In the East it is the custom to give large quantities of iced water. The object is to produce a condition of polyuria, and as the kidneys as a rule are wonderfully free from any distress, their increased function adds to the general well-being of the patient. In cases with severe toxæmia an increase in the amount of urine passed is always a good sign, and it is with a view of more rapidly producing this increased kidney function that large quantities of water are given. Barley-water is a useful addition to the dietary; it is more palatable when slightly acidulated with lemon. Toast and water can also be given. Aërated waters are, of course, counter-indicated in tympanites.

Tea, Coffee and Cocoa.—There is no necessity to prohibit tea, but it must be used in moderation; a patient with extreme asthenia will often relish a cup of tea and milk more than any other drink. If he has been accustomed to coffee in the morning, there is no reason why he should not have a cup of coffee-flavoured milk; but it is counter-indicated when the nervous system is profoundly affected. Similarly, cocoa and milk can be given in the morning to vary the *régime*. It has a pleasant stimulating effect on patients, especially in the later stage of the disease. Neither milk nor coffee is relished in the first week, when the gastric digestion is seriously affected.

Stimulants.—Alcohol in typhoid fever should be considered as a shot in the locker to be kept in reserve for emergencies. In the first week it is not indicated, but as the powers get low in the later stages it is of immense value. Its effect on the pulse is especially to be watched—the slowing of a very feeble, rapid, flickering and dicrotic pulse shows that the required effect is being produced. Either brandy or whisky can be prescribed and added to milk or whey; 4 or 5 oz. per day is not too much for an adult. Even more can be given in cases of heart distress, due to accompanying pneumonia. Champagne is a valuable form of stimulant, as it is palatable and easily retained by the stomach.

Fruits.—The juice of grapes and oranges is a useful and necessary addition to the diet, as the patient would otherwise remain for a very long time without the vegetable portion of his ordinary food. The use of lime- and lemon-juice will be referred to under Thrombosis.

General Remarks.—The practitioner must always be on the defensive in dealing with his case, and requires to show a subtle discrimination in ordering the diet from day to day, and never to trust to any hard-and-fast rule, lest his defence be penetrated. The condition of the excreta, the examination of the abdomen for meteorism, the enquiry into gastric symptoms or abominal pain, the weakening or not of the pulse, and the rise and fall of the temperature, are all factors to be taken into consideration from day to day when prescribing those variations that necessity demands. Curds in the stools will require a modification of the milk diet, diarrhœa may point to some error of broth feeding, a rise of temperature to an excess of food, or the disagreement by a new article prescribed. It is as important to know when to starve as when to feed. Thus, in the first week the stomach, if it prove irritable, should not be overloaded. When diarrhœa and tympanites are pronounced, it may mean the restriction to a small amount of albumin-water and stimulant. Feeding is required in cases with profound toxæmia, cases which in the third week fall into the typical typhoid state, but which have no marked meteorism or diarrhœa. The struggle has yet to be prolonged into the fourth or fifth week: strength is required for it, and such patients will take quite a large amount of food. Here it is necessary to refer to the "**Empty Bowel Treatment**" advocated by Ewart, "Traitement à Vide," feeding that leaves behind the minimum of residue in the bowel; in other words, "No fæces." There is always considerable *débris* from an inflamed typhoid bowel, to which the undigested food is added. This treatment depends mainly on whey, and the removal of the *débris* by constant doses of liquid paraffin, vegetable charcoal being given as an intestinal antiseptic. In connection with this may be mentioned the postural treatment of the bowel—the emptying of the cæcum, by raising the foot of the bed from time to time when it is discovered by percussion that it is full.

VACCINE AND SERUM THERAPY.

Vaccines.—The method of treatment by a vaccine or dead culture was suggested by Wright, and experimented with by Semple and Smallman in India. It is one of some promise, and requires to be tried on a large scale before a final decision can be arrived at. At first glance it is difficult to imagine how any good can come by adding more toxins to the blood already in a toxæmic condition; yet, as in practice, the method is proving useful. Semple's explanation is interesting. The conditions are not favourable to the rapid production of protective substances, because the bacilli are killed off and diluted to such an extent in the blood that the tissues can only make a feeble response. The effect produced is often only toxic, whereas by the inoculation of a vaccine protective substances are produced locally. For this reason the inoculations should never be made in the same place. Better effects were especially produced by autogenous vaccines, that is, by those manufactured from cultures obtained from the case itself. In judging of any case of the disease it is one thing to say it is clinically a case of typhoid fever; but the subject is not as simple as that, for there are a number of infections of the Eberth-coli group which may either appear singly or associated with another of the group or others outside it. There are probably such a variety of typhosus-like organisms that it is impossible to expect a vaccine manufactured from one stock to be of any therapeutic value when applied to a series of cases. Baumann mentions no fewer than forty typhosus-like bacilli, and Rimbaud and Rubenstein record many varieties of the Eberth-coli group. In the writer's experience there have been cases diagnosed as typhoid fever which on further investigation have proved to be paratyphoid or coli infections. These were treated with autogenous vaccines with good results. The Eberth-coli group is a large enough one, comprising as it does Bacillus fæcalis alkaligenes, Bacillus typhosus, B. paratyphosus A and B, B. enteritidis type 1, B. typhi murium, B. suipester, B. psittacosis, B. enteriditis type 2, B. Danysz, B. paracoli, and as yet the subject is still incomplete All these are capable of producing typhoid-like diseases. In an outbreak where a group of persons are involved, a stock vaccine made from an early case can with reason be used for subsequent ones, as the variety of the bacillus is likely to be repeated.

With these facts to hand, it stands to reason that success with the vaccine treatment can only be obtained by having a long series of vaccines to choose from, or a polyvalent stock, or by the use of autogenous vaccines, and along with this the differentiation of the bacillus causing the typhoid-like disease in each case must be made by the bacteriologist. Vaccine treatment should be begun early, before any serious tissue change has taken place. The diagnosis and cultures for the manufacture of a special vaccine will only allow the treatment to be begun towards the end of the second week. This is late, hence the necessity of stocks of vaccine. It has not been proved that inoculation with one of the group will produce a group immunity, otherwise the method would be simple in application. It is preferable to give small doses of from 15 millions to 30 millions of the dead bacilli as a vaccine daily, and that in different places, rather than give one or two doses of 250 millions to 350 millions. Semple now prefers doses of 50 millions to 100 millions. A stock of vaccine is always to hand in the typhoid prophylactic used for inoculations, the strength of which is about 500 millions per cubic centimètre. A dilution of this can be made and the dose calculated. Vaccine-therapy by an autogenous vaccine is very applicable to cases of typhoid carriers, with a view of curing their condition. Several successful cases have been reported, and some unsuccessful. The case reported by Irwin and Houston, of chronic typhoid bacilluria, was cured by several injections, the dose rising to 1,000 millions. In this case the urine was rendered alkaline by sodium lactate. Karl Connell, of New York, has shown that the quality of a highly acid urine, such as is found early in the disease, is inhibitory to the typhoid bacillus in the urine, whereas a weakly acid urine, such as is passed in the declining stage, is a good medium for its growth. Herein lies an indication for treatment by the mineral acids, or by alkalies; in any case, the urine should not be allowed to remain weakly acid. Smallman reports that, in a case of typhoid peritonitis, a vaccine injected locally caused a rapid resolution of the deposit.

In a case of a carrier of six months' standing, showing paratyphoid B. in the urine, under the writer's care, the condition improved at once when subjected to an autogenous vaccine, and was eventually cured in three months' time. Numerous cases of a typhoid-like disease, due to coli infection, have been seen by the writer; the subsequent bacilluria clears up under an autogenous vaccine. One case, after four years' treatment, still remains uncured. The patient, however, is unable to maintain his health unless subjected to a vaccine injection of 5 millions once a fortnight, for otherwise pain and fever return.

Serum Therapy.—If anything is going to prove a specific for the cure of typhoid, it ought to be an anti-toxic serum, manufactured by the injection of horses with typhoid cultures prepared in a certain way, so as to free the endotoxin from the bacilli. Chantemesse's serum, obtained by inoculating horses, was made from bacilli grown in a special manner, McFadyen's and Rowlands's by the grinding up the bacilli in a specially constructed mortar at a temperature of liquid air. This latter was tried by Hewlett, Goodall and Bruce in forty different cases. In three or four a speedy and unexpected recovery ensued. Chantemesse's serum is now abandoned, though it promised so well at first, a series of cases showing only 4·3 per cent. mortality. Here, again, the application of serum, prepared from a certain strain of bacillus typhosus, and used indiscriminately in a series of typhoid-like cases without an exact and bacteriological diagnosis by cultures from each case, whether from the blood, urine or fæces, is unscientific. The facts, which point to the necessity for a series of vaccines being required for clinical purposes, equally point to the necessity for a series of serums (or a polyvalent stock) for the different species of the Eberth-coli group of infections. They point also the necessity for much more work in clearly defining this group and its varieties, and the reduction of elaborate bacteriological methods to simpler and more rapid ones suitable for the clinical differential diagnosis in any one given case. Once the infection is defined, its corresponding serum could then be applied. This opens a wide field for the manufacture of serums. Widal's reaction is probably enough for the diagnosis of typhosus from para-typhosus, etc., but it is so tardy in its appearance that if a serum or vaccine is to be given early the opportunity is gone. Culturing from the blood, if it be done early, and the subsequent differentiation by bacteriological methods, is still a lengthy process, and would be only complete when the patient is improving or the toxæmia profound. It would, however, still be useful when dealing with the later cases of an outbreak in which the infection is presumably derived from one source, as in institutional epidemics.

Other Methods.—It is here necessary to refer to a method used by Jez, by preparing an extract from the spleen, bone-marrow and lymph glands of immunised rabbits. This is given by the mouth in doses of one tablespoonful every two hours, for each case a total quantity of 1 pint or more. Though reported on favourably by some, it has been found useless by others. Widal and others have prepared a serum of bactericidal properties by the inoculation of horses, and find it acts most effectively towards its own particular strain, but variably towards others. Petruschky's method is of small quantities of a vaccine injected in gradually increasing doses. The manufacturing chemists have now placed typhoid serum on the market.

PROPHYLACTIC INOCULATION.

Sufficient evidence is now to hand that this inoculation by Wright's method with a dead vaccine has caused a considerable diminution in the incidence of typhoid fever in bodies of men. Among the Europeans in India the practice is becoming general. There is, therefore, no reason why travellers should not be advised to take advantage of this protective measure. Done as it is at present by a dose of about 250 millions bacilli, and a second dose ten days later of about 500 millions, the local and general reaction is not as severe as it used to be when first introduced. Opinion is gaining ground that the second dose need not be greater than the first, and there is evidence to show that two or three years after, when the agglutinin reaction has fallen to negative, it can be raised again by a small dose of the vaccine.

ANTI-PYRETIC TREATMENT.

A great deal of importance has always been placed on the treatment of high temperatures in typhoid fever. The reduction of the fever lessens the tissue changes and the tissue exhaustion. Of all methods suggested, that of the **cold bath** has been established on the basis of good results and long experience, since it was introduced by Brand, of Stettin, in 1861, though first proposed by Currie, of Liverpool, in 1787. The disadvantages are the number of attendants required to prepare the bath and lift the patient into it, and often the intense dislike evinced by the patient to this form of treatment. The former does not exist in hospitals as attendants are numerous, but in private houses it is a serious consideration; the difficulty can be overcome in private houses by the hiring of a suitable bath, and the rigging up by a carpenter of an oblong wooden frame with rounded edges, over which is stretched by means of screws a panel of stout canvas. The frame also has a simple head-rest on which a soft towel or sponge can be placed, to receive the patient's head. The canvas frame is placed beside the bed in such a way that the patient's legs are first drawn on to the frame, and then the trunk and the head; two attendants hold the frame at either end and lift it and the patient into the bath, which has already been placed close to the bed. The support of the head is important, lest the abdominal muscles contract and press upon the intestines while the patient is being lifted. Two considerations are necessary when carrying out the cold-bath treatment: the pyrexia point above which it is necessary to bathe the patient and the temperature of the bath. Regarding the former, practice varies. Some say when it is above 102° F., some when it is above 103° F. The writer finds that it is preferable not to lay down any fixed point of temperature for these cases generally, above which they are to be bathed; but, that a careful study of the temperature should be made in each case by having it taken every two hours. It will then be found that one, two or three paroxysms of fever occur as the case may be; in mild and convalescing cases one, in moderate cases two, in severe cases three, during the twenty-four hours. When the temperature is rising it should be taken every half-hour, and when once it is found to be steady or showing a tendency to fall, then is the moment necessary for the bath, or any other form of anti-pyretic treatment. The only exception is in the case of a paroxysm of hyperpyrexia, which has to be promptly dealt with. When a temperature is rising any anti-pyretic measure brings it down; but it rises rapidly again, whereas if assisted down the curve it will remain down for some time. The object is to obtain as many intervals of apyrexia as possible, and to make them as long as possible. This method is not only useful in typhoid fever but in other fevers. This, then, limits the bathing to about three times per day, as the case may be. The second point is that of the temperature of the bath itself. Writers differ on this point, some say as low as 65° to 70° F., others 75° to 85° or 90° F. The lower temperatures are certainly the more disagreeable and the cause of much complaint on the part of the patient, and it is not proved that they are more efficacious, except in shortening the bath from ten to fifteen minutes. A higher temperature is slower, but just as useful, and certainly more comfortable. By some it has been averred that the bath has a therapeutic tonic value independent of its anti-pyretic effect. In young adults lower temperatures can be borne, but with the old or the feeble it is well to have recourse to warmer baths. One method is also to begin a bath with a temperature of 85° F., and gradually cool it to 75° F. or lower; while in the bath cold water of a lower temperature can be applied to the head. Gentle massage of the limbs is a pleasant measure to adopt. Previous to the bath the pulse and temperature are taken, and the patient carefully watched while in the bath. The effect on the pulse is noted: as a rule it becomes harder, less dicrotic and slower. If cyanosis supervenes or the pulse becomes feeble, the patient is at once removed, dried, and the circulation restored by warmth. A dose of stimulant before bathing is useful, also water to drink during the immersion. When shivering begins the bath must be stopped. This bathing has a good effect on the nervous system, calming delirium and producing sleep. Statistics are certainly in its favour, mortality having been lessened in institutions where it is regularly carried out. In patients with weakened hearts from any myocarditis or pericarditis, or suffering from intestinal hæmorrhage and peritonitis, the bath is contraindicated. I have seen patients bathed with lung complications, but it is better to adopt the less heroic measure of sponging. Cayley, Barr, Osler, Hare of Brisbane, Ziemssin, Jurgensen, Liehermeister, Rossi and Bouchard are all in favour of cold bathing, authorities enough to show that it is universally recognised as a valuable aid in the treatment of typhoid fever. In India, Forman and Selby have written in its praise. Barr's method was one of prolonged immersion in a tank-bath, with a temperature of 90° to 98° F., more for its therapeutic effect; it is now abandoned, and he advocates a stream of tepid water played on the trunk and abdomen of the patient, who is suspended in a hammock.

Where it is difficult to carry out the cold-bath treatment it is easy to use the **wet pack**; this consists in wrapping the patient in a sheet wrung in cold water. This sheet is kept moist with further additions of water. **Sponging** with iced water, owing to its convenience, is more often employed than any of the above. Here the patient is bared, and the limbs and the trunk sponged in turn, the moisture being allowed to evaporate. In dry climates, where evaporation is rapid, it is very efficacious. It can be carried out in private houses. Vinegar and other spirits are occasionally added to the water to increase the cold produced by evaporation, and are useful in moist climates. A system of Leiter's tubes for cooling the chest and abdomen have been used; also the cold-air bath, which consists in exposing the patient to cold air in cold climates, and in hot weather or hot climates cooling the air by suspending ice in vessels from a frame placed over the patient. Whichever method is employed, it is as well to remember that when a patient is shivering, or suffering from a rigor, with a rising temperature, it is particularly cruel to plunge him into a cold bath, whereas when the temperature is steady, and the patient complains of heat, the cold is then much more gratefully accepted. In the East it is as well to examine cases carefully for enlarged liver and spleen, and to enquire into the history of malaria. In malarial cachectics a cold bath in health is often sufficient to arouse a paroxysm of fever. In such patients the cold bath is contraindicated, and sponging of the limbs and chest is to be preferred; in them, too, cold to the abdomen is not well borne.

ANTI-PYRETIC DRUGS.

Useful as the long series of anti-pyretics have proved in the treatment of fever, they are not used as a routine treatment in typhoid fever, owing to their depressant effect, the danger of cyanosis and collapse and their effect on the blood causing an anæmic change when given for any time. Though well borne at the commencement of the attack they become risky later on, especially if pushed in the same doses as prescribed at first. The rule which we have found useful in the East in dealing with fevers generally by anti-pyretics is to begin with small doses, to raise them gradually, and then to come down again, giving the minimum dose that will produce effect. In the majority of fevers there is a time in the later stages when the temperature is more amenable to anti-pyretic treatment of any sort: thus, if a small dose of 2 gr. of phenacetin be found sufficient to reduce the temperature, there is no point in giving large ones. All these drugs act by producing diaphoresis; if anti-pyretic effect is possible in cold climates without diaphoresis, it is not so in hot climates. This effect is marked and often of some value, especially in typhoid fever complicated by malarial parasites in the blood. What has been said concerning the cold bath in rising temperatures is more than ever applicable to anti-pyretic drugs. With them the effect is bad or useless in rising temperatures; but, when the rise ceases, or the fall begins, then is the time to give the minimum dose found for each case by experiment. The skin will act and the temperature come down, to remain so for some time. It is quite possible to show a long series of cases treated by such and such an anti-pyretic with excellent results and a mortality of, perhaps, 8 per cent.; but this is a normal mortality in some epidemics. It is the mild cases, that do well with anti-pyretics. They are useful means of relief in such cases when nursing in sufficient quantity or quality is not available; but they are better left alone in severe and prolonged cases, where sponging, etc., must be our main stand-by. The attitude of discarding all anti-pyretics in typhoid fever is not the correct one, an occasional dose is a useful measure; but no one would recommend their continued employment as a matter of routine. Of the least dangerous is **Carbolic Acid**; although it is used in typhoid fever as an antiseptic, it is not possible for the small doses of 3 minims or less to have any such effect on the intestinal canal. Given in doses from 1 to 2 or 3 minims dissolved in glycerine and water when the temperature is just beginning to move downwards, it produces a diaphoresis and antipyresis. Its beneficial effect in typhoid fever is due to this effect and not to antisepsis. In plague in the East we have given it in very large doses but without specific effect, except in depressing the temperature. This anti-pyretic use of carbolic acid is not generally known. The **salicylates** are well known as having anti-pyretic properties, though not powerful in this respect. Acetyl-salicylic acid (aspirin) is the most useful of this series: it reduces fever, but produces a good deal of diaphoresis. This drug in the early stage of the disease is not harmful, but rather beneficial in relieving headache. With these two (carbolic acid and aspirin) the practitioner is sufficiently armed, but he has a large choice of **coal-tar derivatives.** These are antifebrin, antipyrin, cyllin, medical izal, kryofin, kryogenin, lactophenin, malakine, phenacetin, bromopyrin, iodopyrin, pyramidon, salipyrin, tolypyrin, tolysal, phenocoll hydrochloride, salocoll, thermodin and kairin, the best known among them are antifebrin, antipyrin and phenacetin; cyllin and medical izal are also used in the so-called antiseptic treatment, but they are both anti-pyretics, being allied to phenol. The general consensus of opinion is against the use of these drugs in typhoid fever as being dangerous, but the literature of the subject shows long series treated with the more common, and among them recently pryramidon. The writer does not use anti-pyretics except with the reservations above made. Experience in the use of anti-pyretics in India is general, and most useful they prove in malaria, febricula due to exposure to the sun, simple continued fever, coli infection and other fevers, but in the typhoid fever of tropical countries they are a weapon to be used with extreme caution. The extensive use of **Quinine** in the early stages of enteric fever in India, when there is a difficulty in the diagnosis from malaria, has at least proved that it has no specific effect; and as it is not a specific it is not of much use. Quinine is often added to prescriptions for cases in the East more with a view of its tonic and anti-malarial effect. It may also be considered an intestinal antiseptic. **Guaiacol carbonate** and **creosote** are also anti-pyretics; in hyperpyrexia a little of the latter rubbed into each armpit and flank often produces a marked lowering of the temperature.

ANTI-SEPTIC TREATMENT.

This is an attempt by the use of antiseptics administered by the mouth to destroy or diminish the typhoid bacilli and the other bacterial flora in the intestinal tract. That it is undoubtedly useful in cases with diarrhœa and offensive dejecta, as in other diseases of the intestines, is common experience; but that antiseptics, given in the doses it is possible to administer without having symptoms of corrosion and poisoning, can possibly have a destructive action on the specific organism of this disease is a hypothesis too absurd to maintain. Moreover, typhoid fever is a bacillæmia with profound infection of the bile ducts, gall bladder and liver; and if soluble antiseptics given by the mouth can have any beneficial effect on the course of the disease it is only possible to imagine that they do so by their absorption through the portal circulation. This may serve as a basis for future experiment, or an explanation why the mercury salts and podophyllin have proved of some value. I have treated severe and prolonged cases of this fever with small doses of calomel throughout, sufficient to move the bowels twice or three times a day. I have noted the stools become bile-stained and less offensive, the tympanites comparatively less; but I cannot say that this treatment has ever cut short the disease, lessened the profound toxæmia or prevented complications. If the secretion of bile be increased (and bile is a valuable intestinal antiseptic), it can only mean pouring more typhoid bacilli into the intestine along with a medium peculiarly favourable to their growth. Here, then, is another obstacle to our advance, and the question arises, is it wise to stimulate the secretion of the liver or not? It may or may not be useful to purge the liver of its bile and bacilli. It is a question that cannot be answered with our present knowledge. Any treatment of the intestinal tract is only a fraction of the work that has to be done, and no treatment relying on this alone can be anything but incomplete.

Calomel and Perchloride of Mercury.—These antiseptics are widely used. It is common practice to begin the treatment of a case of typhoid fever in the first week by a purge consisting of a few grains of calomel; it assists in reducing the headache and clearing the tongue, or preferably it may be given in small doses frequently repeated until the bowels act: thus $\frac{1}{8}$ gr. may be given every two hours. Caution is necessary, as it is easier to produce diarrhœa in typhoid fever than to stop it. If it is decided to continue with calomel, then the practitioner must find by experiment the minimum dose required to give the patient two motions a day. Half to 1 drachm doses of perchloride of mercury liquor [U.S.P. corrosive mercuric chloride, gr. $\frac{1}{32}$ to gr. $\frac{1}{16}$] every four hours, combined with 1 or 2 gr. of quinine, was highly recommended by Broadbent. It has been pointed out that phagocytosis is inhibited by the mercury salts, hence the laboratory condemns what in practice has been found beneficial.

Carbolic Acid is another favourite, but it has been pointed out that it should be used rather as an anti-pyretic, according to the rule laid down above, in doses of from 1 to 3 minims of the liquefied acid in a little glycerine and water. It is sometimes combined with 3 or 4 minims [U.S.P. 1 minim] of tincture of iodine when it is to be used for so-called intestinal antisepsis.

Turpentine (from 5 to 15 minims emulsified with yolk of egg) is highly spoken of, especially in allaying tympanites, in stopping or preventing hæmorrhage of the bowel and in lowering the temperature. An examination of the urine is necessary before embarking on this treatment, lest nephritis be present. It cannot be continued for many days because of its effect on the kidneys.

Chlorine is highly recommended by Yeo; his mixture is freshly prepared chlorine water made by adding 40 minims of strong hydrochloric acid to 30 gr. of potassium chlorate in an empty bottle. As the chlorine is evolved the bottle is corked until it is full of greenish-yellow gas. Water is added little by little, and each time shaken up to dissolve the gas and made up to 12 oz. To this solution quinine, if required, can be added, and also orange syrup. Dose: 1 oz. every two, three or four hours. This mixture has been extensively used in India, and is favourably spoken of.

Bismuth.—The salts of bismuth, especially the salicylate, are of great value in cases with offensive stools and diarrhœa. The salicylate can be given in large doses, if necessary up to 30 gr. three times in the day, but is not to be continued for many days. In cases with constipation it is unsuitable, unless it is given with an occasional dose of castor oil; these, however, are the milder cases, and there is a wide margin of error in such, as the ulceration is generally limited. Bismuth is the nearest approach to a real intestinal antiseptic we have; that and vegetable charcoal as recommended by Ewart. The *charcoal treatment* is carried out by giving liquid paraffin in 1-drachm to 2-drachm doses with charcoal (1 drachm) every four hours, adding sometimes oil of cinnamon (2 to 3 minims). The idea is to relieve tympanites and deodorise the stools, and by the non-absorbable paraffin to promote onward movement of the intestinal contents.

Salol (5 to 8 gr. every four hours) is a useful drug for deodorising the stools. As it is non-soluble in the stomach it passes on to be split into carbolic and salicylic acid in the small intestine. It has no effect on the temperature and must not be continued too long, lest the urine should show carbolic-acid discoloration. Other drugs have been claimed as intestinal antiseptics, such as **Beta-naphthol** and **Resorcin**; they are both to be used with caution, the former causing gastric irritation, the latter diaphoresis and a certain lowering of temperature. They are not to be recommended.

Sulphurous Acid (in 20 to 30 minims every three hours) is extolled as an intestinal antiseptic in tympanites, etc. **Camphor** and **Thymol** are used, but the latter, although insoluble, must not be given with or after alcohol, as it is rendered soluble, and symptoms of poisoning ensue if the dose be large. Here reference may be made to the use of **Potassium Iodide,** which has been popular on the Continent; but there is nothing to prove any specific action, and it is not now employed in England. The **Sulpho-carbolates** have been recommended. The systematic use of **Purgatives** in typhoid fever has received almost universal condemnation; Thistle's paper and Craven's cases, read before the British Medical Association in 1906, on the continuous use of daily ½-oz. doses of the sulphate of magnesia and calomel show at least that a typhoid intestine will sometimes stand a great deal, and certainly give us courage to use an occasional dose of castor oil when constipation is marked, provided it is not at the end of the week when the sloughs are separating. The administration of large **Enemas of Cold Water** throughout the greater part of the illness is not to be considered, as they prove most exhausting to the patient; as a drastic measure in hyperpyrexia they have their use. Enemas are necessary in most cases when constipation is obstinate, and are preferable to purgatives.

Hydrochloric Acid.—This is extensively used in the form of doses of the dilute acid frequently repeated. If there were any drug showing any specific effect, probably this one would be given up; it is used as there is nothing decidedly better. The idea is that as acids are inimical to the growth of typhoid bacilli, it may prevent their increase in the upper part of the intestine. In all hepatic conditions it is a useful drug, and its action is probably beneficial against the hepatic invasion by the bacillus.

The Woodbridge Treatment.—This has been introduced in America by Woodbridge, and is much vaunted. The idea is to produce early in the disease a marked cholagogue, laxative and antiseptic effect by the use in small doses continuously repeated of podophyllin, calomel, guaiacol carbonate, menthol and eucalyptol, followed on the third or fourth day of the disease by the antiseptic and anti-pyretics guaiacol, menthol and eucalyptol only, with occasional use of the cholagogues. Quantities of distilled water are given with, if necessary, a laxative and diuretic mineral water. Care must be taken lest salivation occurs. The prescriptions are made into tablets by Parke, Davis & Co., and sold with Woodbridge's directions. I am inclined to favour any treatment which early in the disease is directed towards the liver, and cases treated by this method seem as favourable as any other.

COMPLICATIONS AND SEQUELÆ.

Treatment of the Skin in most cases consists in maintaining cleanliness and dusting with boric powder. The complications seen on the surface are numerous but not important, such as maculæ, tâches bleuatres, petechiæ, miliaria, sudàmina and prickly heat, which, if irritating, require the application of calamine or lead lotion. In hot climates prickly heat caused by perspiration is a source of considerable discomfort; it is to be met by cool and soothing applications of lotion, or by zinc oxide, salicylic and boric dust. A more serious set of complications are bed sores, circumscribed gangrene, boils and erysipelas. Improvement in nursing and cleanliness has now practically done away with bed sores, but the practitioner has to be on the look-out in protracted cases and examine the back, sacrum, great trochanters, elbows, ankles, shoulders and knees, and to remove pressure from these when there is any sign of redness of the skin. Disastrous consequences due to bed sores, such as exposure and necroses of bone, occur in neglected cases, and in war-time when perfect arrangements are impossible. It is well to remember that anti-pyretics and sulphonal occasionally cause an erythematous rash on the skin. A measles-like rash about the shoulders may be seen rarely, and requires a cooling lotion. Urticaria may complicate matters, either early in the disease when it is associated with the original infection through the mouth, or later when it may be due to drugs.

Treatment of Mouth and Nose.—The hygiene of the mouth is an important thing in typhoid fever. Among the first examinations, it is necessary to glance at the teeth, forbid the wearing of any plates supporting false teeth, and examine the gums for pyorrhœa alveolaris. This is an important point owing to the general loss of the bacteria-destroying power of the intestinal tract during an attack of this fever. It is conceivable that a septic mouth may set up a secondary septicæmia, or secondary deposits of pus-forming organisms, as seen in some cases of typhoid abscess. The brushing of the teeth is to be continued as long as possible by the patient; but when the toxæmia is too profound, or even a small amount of exertion on the part of the patient unadvisable, this duty must be performed by the nurses. For this purpose pieces of soft clean rag wrapped round the finger are effective. With this the teeth and tongue can be cleaned by listerine (1 in 20 to 1 in 10). This preparation should also be used as a mouthwash. The tongue can be cleaned by borax and glycerine, and the lips and mouth moistened with the same to replace the saliva, the diminished secretion of which is very noticeable. The cleansing of the tongue is a great comfort to the patient, assisting in the relish of the food. In order to prevent the accumulation of fur on the dorsum, a little boric-acid powder rubbed on twice a day after the ablution of the mouth has been completed is a useful device. Remembering the liability of ulcers and erosions to appear in the pharynx, the throat should be swabbed out with glycerine of borax or listerine solution. Further, if there are any signs of the larynx suffering, an atomiser, throwing a spray of menthol (gr. 10, dissolved in 1 oz. of paroleine), can be used to spray the back of the throat and larynx. In order to prevent the possibility of facial **erysipelas** complicating matters, it is advisable to keep the nares free of crusts, by the nurse removing these with a handkerchief moistened in listerine, and then dusting in a little boric powder. **Cancrum Oris** is a very unusual complication, but is seen in children chiefly; hence in them every endeavour must be made to keep the mouth clean and examine it from time to time, as well as the inside of the cheek. Early treatment by strong carbolic acid and iodoform may succeed in arresting this condition.

Epistaxis is sometimes severe, and is best dealt with by a swab, dipped into a solution of tannic acid (gr. 10 to 1 oz. of water) fixed to the end of a dressing forceps, pushed up into the nostril, and held against the roof of the nares for some ten or fifteen minutes.

Parotitis is uncommon; it may occur as a late complication or sequela. The writer had one case under treatment which was seen as a late complication, and required incision owing to suppuration. Parotitis may set up septicæmia or pyæmia, due to thrombosis of the internal jugular vein; hence the necessity for early surgical intervention.

The **Œsophagus** may be the seat of ulcers, submucous abscess and subsequent strictures, but these are very rare complications. If diagnosed during an attack, it can only be treated by small sips of glycerine of borax from time to time, after the patient has swallowed sufficient water to cleanse the gullet.

Gastric Inflammation.—A certain amount of gastric disturbance, as evinced by nausea and vomiting, occurs in the first week. This rapidly passes off, but it may continue and pass into a marked gastritis, or later on to an erosion and ulceration with hæmatemesis. The writer treated one patient who succumbed to severe hæmorrhage in the third week. Early in the attack, if there is gastric irritation, desistance from food should be tried for twenty-four hours, lest the condition be perpetuated and nutrition seriously affected. Ice and water only can be given, with perhaps a little whey or albumin-water ; for drugs, bismuth, alkalies, dilute hydrocyanic acid, ingluvin and morphia internally, or by hypodermic injection; nutrient enemata, if possible, and cold or counter-irritation by mustard to the epigastrium. It is as well not to confound the vomiting of uræmia in nephro-typhoid fever and in peritonitis with that of gastritis.

Constipation is a common condition, and is best treated by an enema every second day ; in mild cases castor oil, or olive oil, can be given ; but not early in the third week if there is much tympanites, as this latter often denotes deep ulceration at that time.

Diarrhœa.—This is a more serious complication ; an early diarrhœa is often a warning that the intestinal tract is profoundly affected, and that precautions in dieting and drugging are necessary. Soups, beef-tea, broths and jellies must be forbidden, and only whey or peptonised milk given with albumin-water. Should diarrhœa appear in a severe case in the third week, when toxæmia, anæmia and extreme asthenia are marked, it is necessary to feed and feed liberally in spite of diarrhœa, lest the patient slip through our hands from want of nutrition. For medicines, the bismuth salts are the best, and the question of a dose or two of Dover's powder is to be considered. Persistent dysenteric diarrhœa after recovery has been noted, and I have seen a case after an attack of para-typhoid B. The treatment is by bismuth and astringents.

Tympanites is a source of anxiety, especially after the end of the second week, lest perforation should occur. It is always a little marked, even in mild cases, and a valuable sign in diagnosis. The use of enemata with or without turpentine is often all we can venture to do; if one enema be insufficient, a second should be given. In addition, turpentine should be given internally, 10 minims every four hours, and assisted by hot fomentations with turpentine. An ice poultice is rather drastic. The rectal tube can be put into position with an end in a basin of water to see if flatus passes. It must be borne in mind that retention of urine may be caused by the tube in the case of male patients.

Abdominal Pain is alarming, but it must not be confounded with perforation; fomentations and a minute dose of opium may be given, but it is necessary not to mask this symptom until we are certain of its cause.

Peritonitis and Perforation.—The most common cause of the first is perforation, though peritonitis may occur due to no obvious cause, or be due to bursting of an abscess in a mesenteric gland, or to a splenic infarct or abscess, or to cholecystitis and suppuration. The sudden pain and perforation coming on and spreading over the abdomen, the tympanites, the loss of liver dulness, the vomiting, change in the pulse, and the facies abdominalis are important to bear in mind, as treatment must be prompt if anything is to be done. Laparotomy is the only resource. An operation must be performed within the first twenty-four hours; it must be rapidly done; and the better the surgeon the better the chance of success. The practitioner must, however, be prepared, and the procedure recommended is as follows: Obtain chloroform and an assistant, collect a dozen handkerchiefs, thread four large curved needles with silk or gut sutures for the abdominal wall, and one small straight needle with a fine suture of any material available (chromicised catgut preferred), four artery forceps, one scalpel, one large drainage tube (rubber). Boil all these in a vessel. Clean the skin with tr. iodi, or failing this any antiseptic. Open the abdomen in the middle line; with a handkerchief sponge out the pelvis; if the patient is very ill, adjust the drainage tube, preferably two, from bottom of pelvis to wound, and sew up laparotomy wound by through-and-through stitches. If the patient's condition is good and the peritonitis not very extensive, find the cæcum and follow up the ileum, looking for the perforation; sew when found with Lembert's sutures, adjust drainage tubes, and sew up. It is not always easy to find the perforation, and if there is any delay it is better to give up the search and drain only. The patient has to be kept in the semi-reclining position, and fluid collections in the pelvis sucked up by a glass syringe with a piece of drainage tubing adjusted to its nozzle. Some irrigation of the bottom of the pelvis can even be carried out with sterile water or boric lotion (10 gr. to 1 oz.).

Hæmorrhage from the Bowel is only serious if profuse, as the amount passed is at first no index to how much is occurring; the pulse, pallor, respirations and general condition should be noted. Hæmostatic remedies must be at hand, a dose of opium or morphia given hypodermically at once, then calcium chloride (30 gr.), followed by 10 gr. of the same every four hours. Turpentine (10 minims) every six hours is also most valuable; if this does not succeed, ergot, ergotinine and gallic acid may be tried. Adrenalin is useful when the pulse indicates that the arterial system is being emptied. If collapse is great ether or alcohol may be very cautiously given, and saline injected intravenously or subcutaneously. A simple method of giving this is: Boil 2 pints of water and 2 drachms of sodium chloride, cool, fit a drainage tube over flange of a hypodermic needle, and its other end over nozzle of a common glass syringe, removing the piston. Fill the apparatus with the saline solution, plunge flamed needle into vein or into subcutaneous tissue of flank, and keep pouring in solution as the receptacle empties. The very fine hypodermic needles are useless, and one of large calibre should be chosen.

Venous Thrombosis of one or sometimes both legs is very commonly seen in the East, especially in cases prolonged by slight rise of temperature during convalescence. The general asthenia of the patient, and increase in the clotting power of the blood, is responsible for this complication. It is our practice in India as soon as the danger of intestinal hæmorrhage is over to give fresh lime-juice in barley-water, as the citric acid in this diminishes the tendency of the blood to clot. Too early movement on the part of the patient is counter-indicated; also massage of the limbs is not to be allowed; the writer has seen both cause disastrous results. This complication is a source of anxiety, lest the thrombosis spread to the large veins and pulmonary embolism ensue, and is to be guarded against by keeping the patient absolutely at rest. That arteritis is a sequela of typhoid has been noted. In India we see a number of cases of endarteritis obliterans among natives going on to gangrene which may be connected with typhoid fever.

A certain amount of **hepatitis** and **enlargement of the liver** is seen in typhoid fever cases (about a quarter of the cases), but it is extremely rare that any complications arise. Jaundice is occasionally seen; no special treatment is indicated, but soluble intestinal antiseptics should be avoided. Cholecystitis is always present, but not obvious; this has to be watched in case suppuration ensue. Pain can only be relieved by fomentations. It is as well to examine the liver from time to time, especially in the East, as the writer has known abscess to develop, requiring surgical intervention. In the same way the writer has had occasion to operate on an abscess in the spleen after typhoid fever.

It is usual, in the early stages of the disease, to find a certain degree of **bronchitis** present, but this does not require any special treatment. The rarer bronchitis of the later stage is more serious and requires to be dealt with, especially by cardiac and general stimulants as well as treatment recommended for bronchitis.

Pneumonia.—Lobar pneumonia may be an associated disease either early in the attack of typhoid fever or during the attack, while, especially in the old, hypostatic pneumonia is met with in the later stages. These complications are very serious, especially the latter. The practitioner should be prepared with a supply of oxygen, and use alcohol liberally, and for the heart strychnine and ammonia. During the illness a careful note of the rate of respirations should be kept, as a rise in this is a warning of danger. In prolonged and severe cases, when the toxæmia and anæmia are marked, the respiratory rhythm will rise from these causes alone without any lung complications, and the breathing then has been called "sipping," a term accurately describing it. In such cases stimulants and strychnine are called for. If pleurisy supervenes, it must be treated on the usual lines. We need not go here into the treatment of such complications as abscess of the lung, pneumothorax, hæmorrhagic infarct, gangrene and hæmoptysis.

The **larynx** is not infrequently affected by ulceration, and as this is known to set up abscess, perichondritis, and necrosis and conditions requiring tracheotomy, any affection of the voice should direct treatment to this organ. The hygiene of the mouth, already described, is to be rigorously carried out, and sprays and inhalations of medicated steam assiduously used. A paralysis of the cords associated with other forms of neuritis does not require special treatment except in the management of feeding, which should be in large gulps rather than small sips, when food tends to slip into a paralysed larynx.

The presence of **bacilluria** and its treatment has already been mentioned; a small amount of albumin in the urine is of no great consequence; but an attack of nephritis (nephrotyphoid), with hæmaturia, casts and albumin, is a serious complication, and ties one's hand as far as hydro-therapy is concerned. In this case the milder anti-pyretics, salicylates and aspirin and phenacetin can be used (not carbolic acid or the derivatives of phenol), with cupping or mustard to the loins. It is as well to be prepared to relieve the bladder of its **retention** in the typhoid state. This is apt to be overlooked, hence the frequent examination of the hypogastric region is necessary, especially in men. **Cystitis** is apt to occur (especially in retention), not only with the typhoid bacillus in the urine, but also with Staphylococcus and Streptococcus pyogenes. If this is so severe as to require washing out with boric lotion, it is as well to remember to sterilise the orifice of the urethra as carefully as possible before introducing a catheter. Argyrol (3 gr. to 1 oz. of distilled water) is a useful lotion for irrigation. **Loss of bladder control** is more often seen in women in the typhoid state; it is not of any importance, but the parts must be kept especially clean and dusted with boric powder. This application should be replaced by bismuth or oxide of zinc, if it should cause irritation. Rarer complications are renal abscess and pyelitis, orchitis, abscess, ovaritis and prostatis, this latter proving a source of a typhoid bacilluria.

The Nervous System.—But few cases of typhoid fever pass through the attack without some nervous symptoms. Those most likely to require treatment are the headache and neuralgia of the first week, and the quiet delirium of a later period. For the former, the analgesics are useful: phenacetin, phenalgin, exalgin, given in small doses and used in the way already described for anti-pyretics. Cold or even heat to the head is of some assistance. The low muttering delirium does not admit of much treatment, as at that time all our efforts are being directed against the pyrexia, the asthenia and the complications of the typhoid state. For the violent delirium especially seen in the first week, and often met with in the tropics, portending to the supervention of meningitis, immediate measures must be taken: the hair cut short, and morphia given hypodermically, and every effort made against the pyrexia. In hot climates it is not uncommon to see cases of typhoid fever commencing with a sudden rise of temperature and none of the usual prodromata. They are apt to be associated in young adults with violent delirium and headache, and are taken for cases of sunstroke. The delirium may become maniacal, the patient attempting to do himself injury or showing a suicidal tendency. Such patients require suitable attendants for their restraint; and it is as well to avoid their treatment in an upper storey, lest they succeed in jumping out of a window or off a verandah. Morphia in these cases is our best standby, aided by the bromides. Another class of case is that with symptoms from the first of meningitis; with severe and continuous headache, delirium, vertigo, photophobia, tâches cerebrales, pain in the neck and sacrum, rigidity of the spine and retraction of the neck. I have seen these diagnosed as cases of cerebro-spinal meningitis, a post-mortem showing typhoid ulcers; and, *vice versâ*, true meningitis called typhoid fever. In such cases considerable benefit results from lumbar puncture, and the fluid drawn off may assist in the diagnosis. The use of morphia, cold to the head and body are practically our only resource, as our treatment is symptomatic. No direct treatment can be given to such rare complications as myelitis of the spinal cord and acute ascending paralysis, except lumbar puncture in the hope of relieving the tension and counter-irritation to the spine. At the end of the febrile period the peripheral nerves may be involved—a localised or a more general condition, with acute pain. In cases in which paralysis has not ensued, chronic pain persisting for months has been noted, and passing from one nerve to another of the same plexus, especially in the lower limbs. The treatment by electricity and a subsequent visit to a Spa can be tried. Active treatment at first, such as movement (massage only makes matters worse), rest and time are the most important factors in dealing with this condition. Optic neuritis may complicate matters, as well as retinal hæmorrhage; but such rare complications do not require other than general treatment, and in convalescence measures to prevent atrophy of the disc by use of the continuous current.

Bones and Joints.—The periostitis or osteitis of the ribs, tibia and femur, not uncommonly seen, often pass on to abscess and necrosis, and prove particularly intractable, especially in the dense bone of the shaft of the femur; suppuration sinuses of long duration are apt to follow and resist cure by operation, even when freely done. A periosteal abscess with typhoid bacilli is not necessarily cured by incision and treatment. The healing may be complete, but the condition is apt to recur. It is best to use a vaccine prepared from the micro-organism present. Smallman has had success by the early injection of a vaccine, but it is a question of chance whether the node is due to typhoid or other organisms.

Typhoid Arthritis occurring without suppuration can only be treated on general lines; experiments will no doubt be made in future with vaccines. Those with suppuration are generally due to a secondary pyæmia, and require surgical methods. The treatment of the inflammation of the periosteum and adjacent tissues of the lumbar region, known as " typhoid spine," consists in absolute rest and hygiene. A case in the writer's experience with irregular temperatures was operated on with a view of relieving pus, but none was found. The patient was cured by rest.

Typhoid Abscess, either containing typhoid bacilli or one of the pyogenetic organisms (the two do not seem to be found together), are met with in all parts and organs of the body. The treatment is surgical, and the use of a vaccine should be considered.

Aural Complications.—The slight deafness often seen during an attack requires no treatment, but when aural suppuration and mastoid disease supervene, these will require surgical intervention.

The Heart and Pulse.—Treatment seldom requires to be directed to the heart for endocarditis or pericarditis, as they are rare complications. Myocardial changes occur and may end fatally. Clinically we have to deal with the low blood pressure; this is manifested by the dicrotic pulse, and the increasing weakness of the heart. The pulse is remarkably slow, as has often been pointed out when compared to its rate in the pyrexia of other fevers. A quick and small pulse is a danger signal requiring stimulation. Alcohol, nux vomica, ammonia and tincture cinchonæ co. are then necessary. It is to be remembered that the heart will require to be stimulated for some long period, and it is this point that prevents us using cardiac stimulants that are useful in an ordinary case of collapse. Strychnine by the mouth in small and continued doses or hypodermically is the best; by the mouth it can be continued for some days; caffeine citrate is another useful stimulant; atropine hypodermically is cumulative, the excitement, dryness of the skin and diuresis it is apt to produce are unpleasant. Digitalis is also cumulative and digitalin rather uncertain.

CONVALESCENCE.

The treatment of convalescence lies principally in being on guard for the sequelæ. Solid diet is only to be ordered after ten days of normal temperature, in some cases even more; here it is a question of judgment of the severity of the case and of the absence of complications. A gradual increase in the amount of liquid nourishment is necessary, as it is important to assist the patient in regaining of strength and in avoiding thrombosis. It is difficult to indicate any line of treatment which ensures the absence of a relapse; the experience is against any sins of commission, such as irritation of the intestines, by giving solid food early in the convalescence, though some authorities have said they have learnt to satisfy the cravings of their patients. In the East with severe cases we are very cautious on this point. The anæmia and asthenia of convalescence require the administration of iron preparations and tonics of quinine and arsenic. When convalescence is established, it is as well to examine the urine, lest albuminuria be present. The return of the patient to ordinary life is a question of some time, and can seldom be made until after a month, and in complicated cases a much longer interval is essential.

J. REID ROBERTS.

TYPHUS FEVER.

At the present day few practitioners ever see a case of typhus fever. Improved sanitary conditions have practically stamped it out in this country, though it occurs sporadically each year in such towns as Liverpool and Glasgow.

General Management.—Typhus is an extremely infectious disease, but the poison which is given off in the patient's breath and exhalations is quickly rendered inert by free dilution with air. Abundant *ventilation* is therefore a cardinal point in the treatment of this fever, for the sake of the patient as well as of those who are attending on him; for not only is the death rate much lower among those who are treated in a constant current of fresh air, but the risk to others of catching the disease is thus reduced to a minimum. It can truly be said that there is no disease, with the possible exception of pulmonary tuberculosis, in the treatment of which fresh air is of such prime importance as it is in typhus fever. No question of draughts or complaint of feeling cold on the part of the patient should be allowed to influence the ventilation. Hot bottles and more blankets may be given to him, but the windows should on no account be closed. This increase in the bedclothes is especially likely to be needed at the time of the crisis and just after. Cases of typhus should be sponged night and morning with tepid water to which has been added a little eau-de-Cologne or spirits of lavender, as the refreshing effect of the sponging will thus be increased, and the unpleasant odour associated with the disease diminished. Special attention ought to be paid to those regions on which *bedsores* are likely to develop, as this complication is not uncommon in typhus fever, even with good nursing. The back should be washed twice daily, and spirit in some form well rubbed in afterwards. In this disease the toilet of the mouth is one of the most important nursing details, since it not only removes a source of discomfort, but it also diminishes the objection to food. When the tongue is dry and brown, and the teeth covered with sordes, the oral cavity should be cleansed at least every four hours during the daytime by means of strips of lint wrapped round a pair of dressing forceps, or the forefinger, and dipped in an antiseptic mouthwash. The tongue, roof of the mouth, and both sides of the teeth and gums should be carefully and systematically gone over, assisted by the use of a toothbrush. *Retention of urine* is likely to occur in typhus fever, for which reason the hypogastric region should be percussed daily, otherwise retention with overflow may be mistaken for incontinence. During the second week, when the patient is lying in a state of low muttering delirium, he will probably pass both urine and fæces into the bed. Should this happen, placing large pads of brown and absorbent wool beneath the patient's buttocks helps to keep the bed clean and obviates the frequent changing of the draw sheet that might otherwise be necessary. During this period the patient should not be allowed to lie altogether on his back, but should from time to time be turned first on to one side and then on to the other, being kept in position by means of pillows. This will lessen the chance of a bedsore occurring and diminish the tendency to congestion in the bases of the lungs. When convalescence is once established the patient's progress is usually very rapid. He should be isolated for at least a month from the commencement of the illness.

Remedial Treatment.—*Pyrexia* may be controlled by cold sponging or the use of the wet pack. Antipyretic drugs should not be administered. Severe *headache* is sometimes a troublesome symptom at the commencement of the illness. Effervescing citrate or hydrobromate of caffeine will sometimes relieve it; while an ice-bag or a Leiter's coil may be applied to the head or a strip of mustard leaf to the nape of the neck. For *insomnia* chloralamide is the best, because the safest, hypnotic. It must be completely dissolved in a spirituous solution before it is administered; otherwise its action is much retarded. An adult should be given an initial dose of 40 gr., followed by half that quantity hourly until the sleeplessness is overcome, or a total of 120 gr. has been administered. No fear need be entertained of this drug acting as a cardiac depressant. Should the patient be wildly delirious, he can usually be restrained by fastening a sheet across him, but if this fails, he must be tied down in bed, and a hypodermic injection of hyoscine ($\frac{1}{200}$ to $\frac{1}{100}$ gr.) may be tried in addition to quiet him. *Constipation* should be treated with simple enemas, as purgatives are liable to set up a troublesome diarrhœa.

Diet.—During the acute stage this will consist of liquids. Three pints of milk in the twenty-four hours well diluted, a suitable proportion being 5 oz. of milk to 3 oz. of water, and a pint of good beef-tea may be given to an adult. The patient should also be induced to take abundance of cold water, while home-made lemonade is likely to be acceptable. This is a detail of some importance, as the water produces a beneficial effect, it is thought, by washing the toxins out of the tissues and causing their removal in the urine. Great stress is laid on this free administration of water by most physicians who have had experience of typhus fever. The diet can be safely increased as soon as the patient expresses a desire for solid food.

Stimulants must be used in this disease with care and discretion; the routine administration of alcohol is likely to do harm rather than good. According to Dr. Claude Ker the majority of adult patients require it at about the time the crisis is due, but children are better without it. Should the frequency of the pulse, or a dilated condition of the heart, indicate the need for stimulants early in the second week, caffeine and strychnine should first be tried, and alcohol kept in reserve if possible.

F. FOORD CAIGER and H. E. CUFF.

ULCERATION.

In considering the treatment it is not intended to attempt an elaborate classification of ulcers. It may be said at once that such conditions as gummatous ulcers, ulcerating malignant growths or tuberculous ulcers present special features which, as a rule, render their diagnosis easy. They need special treatment, and are dealt with under the appropriate heading. They will not here be further dealt with. It will suffice to point out that the ulcer will present itself to the surgeon in one of three conditions.

(1) **The Inflamed Ulcer.**—The surface of the ulcer is yellow and sloughy. Small necrotic masses are scattered over it. There is a thin purulent discharge. The parts surrounding the ulcer are swollen, red and painful, and in some cases a spreading cellulitis may develop. The ulcer is more or less rapidly spreading.

(2) **The Chronic Ulcer.**—In this variety the ulcer shows no inclination to heal. Spreading is not rapid, but nevertheless the ulcer, unless treated, slowly but surely increases in size. The surface of the ulcer is covered with unhealthy granulations, sometimes excessive and œdematous. There is a discharge of thickish yellow pus. The margins of the ulcer are often raised above its surface, sometimes pale and flat, sometimes the site of eczema.

(3) **The Healing Ulcer.**—In this case the surface of the ulcer is covered with healthy granulations, the margins are level with the surface, and the skin is normal in appearance, apart from some slight hyperæmia. When active healing is proceeding there is a narrow, dry, red zone at the margin of the granulating surface indicating the spread of epithelium over it. This condition resembles a granulating wound, but differs from it in that the healing process is very slow, and, in the absence of careful treatment, the ulcer is likely to be infected and become inflamed, or gradually to assume the characters just described as characteristic of a chronic ulcer.

INFLAMED ULCERS.

Complete rest must be ensured, the limb raised, and general constitutional measures must be adopted. The ulcer is dressed every four hours, the surface being washed over with biniodide of mercury lotion (1 in 4,000) and boracic fomentations applied. In more severe cases the surface may as a preliminary be swabbed over with pure carbolic acid—the pain caused is transient. Liquor aluminii acetici, diluted with twice the quantity of water, on strips of lint, is very useful for foul ulcers. When there is much offensive odour the liquor sodæ chlorinatæ of the Pharmacopœia may be applied on pieces of lint and the fomentations applied over them. Treatment on these lines is continued until the inflammatory condition has subsided. There will remain in many cases a healing ulcer which will need treatment on the lines laid down under that heading. On the other hand, the inflammation may have been a septic complication added to an old-standing chronic ulcer. After subsidence of the process, therefore, a chronic ulcer will remain, and the usual treatment of that variety must be proceeded with.

Phagedænic Ulcers are not of common occurrence, but need active treatment. In the milder cases pure carbolic acid is applied to the whole of the ulcerating surface. In more severe cases, where there is extensive sloughing and marked constitutional disturbance, an anæsthetic should be given, and with scissors and forceps the slough should be cut away and the whole area freely cauterised with a Paquelin's cautery at a white heat. Fuming nitric acid is sometimes employed instead of the actual cautery: after being allowed to act for three or four minutes the acid is neutralised with a strong solution of washing soda, until no more effervescence takes place. This method is inferior to the former. Appropriate constitutional treatment is of great importance. When the rapid progress of the ulceration has been arrested, fomentations are applied and the case is treated as one of inflamed ulcer.

CHRONIC ULCERS.

Before proceeding to deal with the special measures called for in the individual varieties of chronic ulcer, the general measures needed in all cases of chronic ulceration will be mentioned. They are: (1) *To provide absolute rest.* In the case of the lower limbs strict confinement to bed is essential if the best results are to be obtained. Unfortunately this is, for economic reasons, impossible for the patients of the very class which provides almost exclusively the sufferers from chronic ulcers. The out-patient department of every hospital is crowded with such. Nevertheless it must be repeated that complete rest—not the "getting about the house and resting on the sofa" type of rest—is essential, and that without it many chronic ulcers may be looked upon as incurable. (2) *To assist the venous return* is the next object in view. The limbs should be raised so that the foot is the most elevated part. No constricting bands, such as garters, are to be permitted. (3) *To cleanse the surface of the ulcer.* The skin surrounding the ulcer is well washed and shaved and disinfected with a weak antiseptic lotion (biniodide, perchloride or carbolic), and this procedure is called for every few days throughout the treatment of the case. Boracic fomentations are then applied until the yellowish sloughs come away and the surface of the ulcer gradually assumes a more healthy appearance. If fomentations are found ineffectual, the surface of the ulcer may be treated with pure carbolic acid and the ulcer afterwards dressed with gauze, wrung out of perchloride lotion (1 in 4,000), but this dressing should after two or three days be replaced by the boracic fomentations. As soon as the granulations become more healthy and the sloughs have separated, the lines of treatment laid down for the healing ulcer are to be adopted.

While these are essentials in the treatment of all chronic ulcers, special forms need, as already mentioned, special treatment. The forms of chronic ulcers will now be dealt with separately. It should be understood that when once the treatment indicated has been effectual in bringing about the presence of a healthy healing ulcer, the treatment to be subsequently described for such an ulcer is to be adopted.

Callous Ulcer.—As already mentioned, the edge of an ulcer is often raised above its surface. When this condition is well marked so that there is a thickened and indurated zone of skin and subcutaneous tissue round the ulcer, and the surface of the latter is flat, pale, and devoid of granulations with but little secretions, the term "callous ulcer" is applied. The condition of the edge is due to the exudation of lymph into the tissues and its subsequent coagulation. The flow of blood to and from the ulcer is greatly interfered with, and no chance of healing exists until the surrounding thickening and induration are removed. Whilst it is true that rest and elevation of the limb will in time enable absorption to take place, many measures are employed to hasten the process. Pressure over the site of the ulcer and the neighbouring parts is one of the best of these, and Unna's bandage is the most useful method of applying it. The technique is as follows: After cleansing the ulcer carefully it is covered with a layer of sterilised gauze. The leg is then elevated for a quarter of an hour, and a carbolic gauze bandage is applied from the toes to the tubercle of the tibia. The bandage should be made to lie smoothly without ridges, the edges of the bandage being snipped here and there to accomplish this. The "reverse" should be avoided. Whilst this is being done the Unna's paste (gelatin, 5 parts; zinc oxide, 5 parts; boric acid, 1 part; glycerin, 8 parts; water, 6 parts), is melted in a water-bath and allowed to cool sufficiently. It is now painted with a brush over the whole of the bandage. A second layer of bandage is put on and painted over as before. A third or even a fourth bandage is applied, if necessary, to give a firm support. The whole is then covered with an ordinary calico bandage, which prevents the clothes from sticking to the gauze bandage and the latter from fraying. If the ulcer is of large size and discharges profusely, the bandage may need changing as often as every other day, though, generally speaking, once a week is sufficient. The bandage is readily removed by soaking in warm water, which melts the gelatine. Allusion has already been made to the difficulty of treating ulcers of the leg, arising from the fact that the patients are not able to lie up. Unna's method of treatment will give a prospect of healing in many cases when rest is impossible, and is by far the best method of ambulatory treatment. Martin's rubber bandage is also used for applying pressure, being wound around the limb over the dressing. Strips of strapping encircling the limb with their ends crossing over the site of the ulcer are employed for the same purpose. The strips should be 1 inch wide, and each should overlap about two-thirds of the breadth of the one below. Crêpe velpeau bandages are also useful in applying pressure, but none of these measures are so effective as Unna's dressing.

A favourite method of treatment with some is to blister the callous edges; blisters should not be applied to the ulcerated surface itself, and a warning is necessary as to the danger arising from the absorption of cantharides (the usual blistering agent) in cases of renal disease. If pressure and blistering fail to improve the condition of the edges of the ulcer, a circular incision may be made through the skin, completely surrounding the ulcer at a distance of 1 inch. The ulcer should be previously disinfected, and frequent dressings are necessary afterwards to prevent severe infection spreading from the site of the incision. Others employ radiating incisions, passing through the surface of the ulcer and its thickened margins. Massage is a simple and fairly effective method of getting rid of the œdematous and indurated edges of these ulcers. It should be applied first to the upper margin of the sore and afterwards to the lateral and then to the lower margin.

Varicose Ulcers.—Chronic ulcers of the leg are, in the majority of cases, associated with and dependent upon the presence of varicose veins. The ideal method of treatment is to deal with the ulcers on the general lines laid down, and then to deal with the varicose veins by operation, when healing is complete, before the patient is again allowed to walk about. Whilst rest and elevation are maintained, the presence of varicose veins does not materially retard the healing process, and from the point of view of surgical technique it is better not to operate while a discharging ulcer exists. When circumstances render prolonged and complete rest impossible, the veins should be supported by crêpe velpeau bandages or Martin's rubber bandage, or an elastic stocking, or, better still, Unna's bandage. In bad cases the vein should be dealt with at once by operation after preliminary careful disinfection of the ulcer and surrounding skin. Varicose ulcers are often surrounded by and associated with large patches of eczema. When ulceration is threatening in a patch of eczema the application of Unna's bandage gives excellent results.

Anæmic Ulcer.—Ulcers are often associated with anæmia. The granulations covering them are pale and flabby, the edges anæmic and flat, and the ulcer, even when clean, shows no tendency to continue the healing process. If the ordinary treatment for anæmia is instituted, these ulcers will often make rapid progress.

Excessive granulation should be treated by rubbing with solid nitrate of silver, or in more advanced cases by scraping with a sharp spoon.

Imperfect granulation, when the surface is flat and indolent, may be treated by the application of lotio rubra; Zinci Sulphatis, gr. 2; Tinct. Lavandulæ Co., ♏10; Aquam, ad ℥j.

Œdematous granulations are caused by varicose veins, cardiac and renal disease. The appropriate treatment for these conditions is instituted, and when the ulcer has become clean, moist applications should be abandoned, the protective dressing subsequently described being unsuitable. A mild ointment changed twice daily is the best dressing.

Irritable Ulcers.—These are usually situated over the external malleolus. They are small, but intensely painful. Frequently menstrual disorders exist, and will need treatment. The best local treatment is to excise the whole ulcer and subsequently to skin-graft. This is, however, only feasible when the ulcer is small and the surrounding skin healthy. When these conditions are not fulfilled the surface of the ulcer may be cauterised with silver nitrate. When a definite spot is found, suggesting the existence of an exposed nerve terminal, a transverse incision may be made a short distance above with a view to dividing the nerve fibres involved.

Perforating Ulcers.—These are due to traumatism, in the form of pressure applied to a part the vascular supply of which is defective owing to changes in the blood-vessels, and the innervation of which has been interfered with by disease or malformations of the spinal cord, or injury of that structure or the nerves which are connected with it. Diabetes and tabes dorsalis are the causes most frequently found in practice. Other diseases of the cord, spina bifida, nerve lesions and leprosy, occur less commonly. The ulcers are almost always on the plantar aspect of the metacarpo-phalangeal joint of the big toe. In dealing with treatment, prophylaxis may first be touched upon. Special attention must be paid to callosities occurring on the feet of those subject to the diseases enumerated. The careless paring and cutting, without any attempt at cleanliness, which is usually adopted for such conditions is to be avoided; the pressure of ill-fitting boots is to be removed. When a perforating ulcer is established, involvement of bones and joints is a matter only of time unless treatment is adopted. In the first place the causative condition is to be treated on the usual lines. Massage and hot douches may improve the circulation through the leg. Electricity may assist when innervation is interfered with. Iodides may be useful in the treatment of tabes, and a diabetic *régime* is ordered when necessary. Locally all pressure is to be removed from the ulcer, and rest and elevation are desirable. Moist, antiseptic applications or fomentations are applied, the feet generally being kept as clean as possible. Thickened masses of skin around the ulcer are pared, and when, as is usually the case, a mass of sodden epithelium occupies the cavity of the ulcer, this needs scraping or cutting away. When bones or joints are involved, scraping may be resorted to. The ulcer is then plugged with strips of cyanide gauze, and an attempt made to get the cavity filled with granulations, and so to secure healing from the bottom. When septic tracks or sinuses exist, burrowing through the foot from necrosed bone at the bottom of the ulcer, they must be slit up, disinfected and packed. Amputation may be performed in more intractable cases, but must take place through healthy tissues. In diabetic cases considerable care must be exercised before adopting operative proceedings. In this disease, at any rate, such measures as amputation at the metacarpo-phalangeal joint are almost always failures. Widespread suppuration in the foot ensues, and the patient is fortunate if he escapes with his life. If amputation is decided upon after due consideration of the patient's general condition, the degree to which the presence of the ulcer is affecting it, and the disability and discomfort suffered, the limb should be removed at the knee-joint or through the lower part of the femur. In other cases than those due to diabetes local amputations are more effectual, and, since there is not the danger of coma to be faced, amputation of the great toe with its metacarpal bone, provided that healthy flaps are obtainable, may be performed. The surgeon must largely be guided by the condition of the circulation and nutrition of the part. Chipault claims strikingly successful results by stretching the posterior tibial nerve, combined with scraping or excising the ulcer. The nerve is exposed behind the internal malleolus and stretched by inserting a blunt instrument beneath it.

THE HEALING ULCER.

When by means of the various forms of treatment which have been described the ulcer has been brought to the condition indicated by the term "healing ulcer," measures are taken to protect the granulating surface from injury and to hasten the spread of new epithelium. One of the best ways of dressing is to apply green protective, with small holes cut to allow of the exit of discharge, directly to the granulating surface and overlapping it for ¼ inch. Over this are placed layers of plain sterilised gauze, which may be wrung out of boracic lotion, but should contain no strong antiseptics. Other favourite dressings are boracic or zinc ointment, yellow oxide of mercury ointment, double cyanide ointment and other oily preparations. Of these the non-irritating boracic ointment is the best to use, but should be one-fourth of the B.P. strength and made with softer paraffin. When with treatment on these lines the ulcers show little signs of healing, skin-grafting by Thiersch's method is to be employed. It must be remembered that when skin-grafting is employed in a case of old-standing ulcer of the leg, prolonged rest is needed afterwards. Otherwise the ulcer is certain to break down again as soon as the patient starts walking. Three months' rest with the leg raised is the minimum time in which an old ulcer of the leg, which has been with difficulty persuaded to heal, can cicatrise with sufficient completeness to remain intact when the patient resumes walking. It is a very common matter in hospital work to be told by a patient that an ulcer will heal with rest, but breaks down again as soon as the patient recommences to get about. In many cases some definite factor retarding the process of healing can be found: thus inability to contract is a frequent cause of failure to heal. This inability may be due to dense, thick scar-tissue around the ulcer, or to the base of the ulcer having become adherent to the subjacent bone. In the former instance it is possible in a few cases, when the ulcer and surrounding scars are of small extent, to excise the whole and close the resulting wound by some form of plastic operation, or to skin-graft the surface left. Where this is impracticable, skin-grafting may be effectual, the granulating surface having been first scraped until healthy firm tissues are exposed. Results are not very satisfactory, as even if the graft takes, ulceration is very likely to occur again, since the previous inability to contract still remains. Sometimes the ulcer may be made to heal by incising the healthy tissues deeply beyond the margin of the ulcer and the dense scar. When the ulcer is adherent to bone the edges of the ulcer are detached from the bone with a sharp scalpel and raised from it. The thick margin is then cut away all round, and the surface of the ulcer is scraped. Some form of plastic operation may now be employed, and any part of the raw surface not covered is skin-grafted. Other plastic operations have been designed in which flaps of skin are raised from remote parts of the body: thus a denuded area caused by an ulcer of the arm has been covered by a flap raised from the front of the chest. A flap of appropriate size is raised, a pedicle being left, stitched over the ulcer and the arm firmly bandaged to the chest. When the flap has adhered the pedicle which still connects it with the chest is divided. Skin-grafts are employed for the bare area left on the chest. No plastic operation must be attempted when active suppurative processes are going on in the ulcer.

MAYNARD SMITH.

WHOOPING COUGH.

Prophylaxis.—Whooping cough is usually regarded as one of the inevitable diseases of childhood, and consequently little or no trouble is taken to check its spread. It may, however, be quite worth while to try to prevent it in young children and in those who are constitutionally delicate or already suffering from any other illness, as it is amongst these classes that the chief mortality occurs. In previously healthy children over three or four years of age the death rate from the disease is exceedingly small.

It is highly infectious, but only by fairly close personal contact, for the experience of children's hospitals shows that, unlike measles, it seldom spreads in a ward in which all the patients are kept in bed. The infectivity is undoubtedly greatest in the early or catarrhal stage. How long it persists is uncertain; until the whoop has ceased is the generally accepted time. In many cases this is doubtless too long, for the whoop may be as little an indication of infectivity as is probably the last stage of prolonged desquamation in scarlet fever. The public, however, will no doubt always regard a child who whoops as still dangerous. Certainly, the recurrent whoop which sometimes for many months after an attack of whooping cough is apt to be excited by any catarrh of the respiratory passages does not indicate the slightest risk of infection. We are probably safe in saying that very few patients need be isolated for more than six weeks from the commencement of the illness, and when the disease is mild a shorter time may be quite sufficient. Cases are on record which prove that infection may be carried by persons not themselves affected, if any secretions from the patient have got on to their clothes; but those in attendance upon the sick can safely mix with susceptible children provided they wear a washable overall, and as soon as they leave the sick room remove this and wash their hands and face. At the end of the illness the patient's room should be disinfected before being occupied by susceptible children. It may not be necessary to carry out the complete disinfection required, for instance, after scarlet fever, but at least all carpets should be taken up (if possible they should be removed from the sick room at the beginning of the illness; a cork linoleum is much more suitable), the floor and furniture washed over with a solution of carbolic acid, and the room thoroughly ventilated for two or three days. All clothing and utensils used in the patient's rooms should also of course be disinfected, and during the illness nothing should be sent out of the rooms without previous disinfection.

The *incubation period* of whooping cough is uncertain and probably varies a good deal. It may be at least a fortnight, sometimes rather longer. It is obviously difficult to fix accurately owing to the very insidious onset. As, however, the disease is probably infectious from the very commencement of the catarrhal symptoms, susceptible children who have been exposed to infection should be regarded as liable to develop the disease, and therefore as potential sources of danger to others, for not less than three weeks from the last exposure. It must be remembered that in some recorded cases the incubation period has apparently been only three or four days, and that consequently a child may become infectious within that time. The chances of a second attack are so small that persons who have had the disease and subsequently been exposed to infection need not be regarded as sources of danger by reason of their being likely to acquire the disease again.

General Treatment.—It is notorious that all the acute infectious diseases vary enormously in severity in different patients and in different epidemics, some cases being almost malignant in character, whilst others run a more or less abortive course, and may, in fact, be so slight as only to be recognisable by reason of the prevalence of the disease at the time or of a definite history of exposure to infection. Whooping cough is no exception to this general rule; in some instances the child is scarcely ill, the whoop is never pronounced, and all symptoms may have completely disappeared in three weeks or so from the onset; in others lung complications of the gravest character supervene before even the diagnosis of whooping cough has been definitely established. At times the early symptoms are of a severe type, yet improvement rapidly occurs and the disease subsequently runs a mild and comparatively short course. These facts render any inferences which may be drawn as to the apparent success of special methods of treatment exceedingly fallacious, for when improvement occurs, no matter how quickly, we have no certain means of determining whether it is really due to the treatment or merely to the natural course of the illness. Although, however, in certain cases or even epidemics, some particular drug or method of treatment may appear to be highly beneficial, all prolonged experience shows that we have at present no specific for the disease, nothing which can be definitely relied upon either to shorten its duration or even materially to relieve symptoms in every case. The number of remedies recommended is sufficient evidence that no one of them is really satisfactory. At present all we have to aim at is to maintain the general health of the patient at as high a level as possible, to prevent the complications and sequelæ of the disease, remembering that uncomplicated whooping cough is rarely if ever fatal, and to some extent to diminish the frequency and severity of the paroxysms.

Children suffering from whooping cough require close personal care. They should not be left unattended during the attacks; they are often much alarmed when they feel a paroxysm impending and naturally run to the mother or nurse for support; the violence of the cough may lead to vomiting, to epistaxis, to involuntary escape of urine or fæces, and even to partial transient loss of consciousness, whilst help is often needed to get the viscid, stringy, mucous sputum out of the mouth. Much may be done to diminish the frequency of the attacks by avoiding, as far as possible, those causes which are known to give rise to them, especially excitement and emotional disturbances of all kinds, gastric disorders, physical effort, draughts of cold air, getting into a cold bed, etc. Support to the abdomen by a broad elastic belt may serve to diminish the strain of the cough.

No absolute rules can be laid down with regard to confinement to bed or to the house; so much depends upon the age of the patient, the weather, the severity of the attack, and even the prejudices of the parents. So long as there is any fever, certainly if the child's temperature rises to 100° F. or higher, at any time during the twenty-four hours, he should be kept in bed. Even when the temperature is quite normal he should remain indoors whilst any physical signs of bronchitis are present. The younger the patient the more care should be taken, especially at the commencement of the attack and during the winter and spring, the periods when whooping cough is unfortunately most prevalent. Whilst confined to the house the child should be kept in one or, preferably, in two rooms, one for day and one for night. These should be freely ventilated, but their temperature whilst occupied should not be allowed to fall below 60° F. In the early stage of the disease the slight bronchial catarrh which is nearly always present readily passes into severe bronchitis or broncho-pneumonia. These complications may undoubtedly be the result of a chill, but it is also probable that they are largely due to breathing an impure atmosphere, just as the common "cold" is caught for the most part in stuffy, badly ventilated rooms and not in the open air. Whether, therefore, these secondary lung troubles are due to the actual poison of the whooping cough or to a separate infection by other microbes, special care should be taken to secure for the patient an abundant supply of fresh but properly warmed air. Under such conditions the danger of complications is greatly diminished, the general health of the child is less likely to be seriously affected by the disease, and the duration of the latter may be somewhat shortened.

Diet.—It must be borne in mind that there is a great tendency, especially in the earlier stages of whooping cough, to gastro-intestinal catarrh, a result partly of the general febrile disturbance, partly of the irritant action of the sputum which is almost invariably swallowed by young children, and partly of the tendency, always noticeable in early life, for any catarrhal condition of the respiratory mucous membrane to extend to that of the alimentary canal. Such gastric disturbance is of especial importance in whooping cough, because it greatly increases the liability to vomiting during the paroxysms. The child's food, therefore, should be light and digestible, with especial restriction of fermentable carbohydrates, such as potatoes, new bread, farinaceous puddings, etc. Young children should be fed on milk, eggs, custard puddings or liquid custard, jellies, broths or beef-tea, toast, rusks, and a little butter; older ones may have in addition fish or minced meat.

The bowels should be kept freely open, and if there is any tendency to constipation, with furring of the tongue, a child between one and two years of age should have some such powder as the following: ℞. Hydrargyri cum Creta, gr. ½ to 1; Pulveris Rhei Radicis, gr. 2 to 3; Pulveris Cinnamomi Co., gr. 1; every night or night and morning. Undoubtedly a liberal supply of fresh air tends greatly to diminish the danger of stomach disturbance and so of vomiting.

External Applications to the chest are often beneficial, and have the additional advantage that, unlike many of the drugs given internally, they do not tend to upset digestion. Obviously they are especially indicated if there is much bronchitis. Turpentine liniment is perhaps the most useful, as probably the inhalation of the turpentine vapour increases its efficacy. If the bronchitis is at all severe poultices of linseed, with a little mustard added in proportion to the age of the child, may be employed for a few days.

Inhalations and Sprays.—There are a number of substances, inhalation of which undoubtedly in many cases diminishes in a greater or less degree the frequency and severity of the paroxysms. The most popular at present is Cresolene. A teaspoonful of this may be slowly evaporated from a suitably constructed vaporiser (such as is sold with the preparation) two or three times during the twenty-four hours. If expense is of importance a teaspoonful or two of crude carbolic acid or of creosote may be used instead, or a teaspoonful of either added to a pint of boiling water and the steam inhaled. The great drawback, however, to all inhalations is that they interfere more or less with that free ventilation of the room in which the child is living, which, as already stated, is of so much importance. A great variety of sprays, paints, douches, insufflations, instillations, etc., to the nose, pharynx and larynx have been recommended at different times. A spray of a 1 or 2 per cent. solution of resorcin may be especially mentioned. Any benefit, however, which these remedies may effect is rarely commensurate, at least in the case of young children, with the risk of frightening the patient and so exciting the paroxysms, and if they cannot profitably be employed in early life their chief field of usefulness is lost. When the paroxysms are of exceptional severity, a few whiffs of chloroform at the commencement of each afford considerable relief. As the administration must necessarily be left mainly to the nurse, it has been suggested that all danger of an overdose may be avoided by instructing her to pour a few drops of the chloroform on the back of her hand at the beginning of each attack, and then to hold this over the child's face. Nitrite of amyl has been used for the same purpose.

Medicinal Treatment.—In regard to the administration of drugs by the mouth it must be borne in mind that in a considerable proportion of cases of whooping cough none are needed throughout, except perhaps an occasional simple laxative to regulate the bowels, whilst the child is necessarily kept in bed or indoors, and a tonic during convalescence. When the number of paroxysms does not exceed ten or twelve per diem, with little or no vomiting and no appreciable bronchitis, it is futile to give drugs, the beneficial action of which is probably quite uncertain and which may be potent for harm. In more severe cases, however, drugs may help in the catarrhal stage to relieve the bronchitis and afterwards in the paroxysmal stage to diminish the frequency and the severity of the attacks, and perhaps to some extent to hasten cure.

At first, probably the most efficacious remedies are those ordinarily given for bronchitis, especially ipecacuanha and acetate of ammonia; if there is much secretion a stimulant expectorant, such as carbonate of ammonia, is desirable, and iodide of potassium may be useful in helping to liquefy the thick, tenacious mucus which is commonly so marked a feature of the disease, and which the child has such difficulty in expelling. To a patient a year old we may give, therefore: ℞. Ammonii Carbonatis, gr. $\frac{1}{2}$; Potassii Iodidi, gr. 1; Vini Ipecacuanhæ, ♏$2\frac{1}{2}$; Glycerini, ♏5; Liquoris Ammonii Acetatis, ♏20; Aquam, ad ʒj; every four hours. It is a common practice to add to the above mixture bromide of potassium (2 gr.) and tincture of belladonna (2 to 3 min.), but the sedative influence of the former upon the cough is extremely slight, if indeed it can be said to exist at all, whilst belladonna is more likely to be of use somewhat later in the course of the disease.

When the paroxysmal cough is fully developed the special object of treatment is to try to diminish the frequency and the severity of the attacks. For this purpose a large number of sedative, anti-spasmodic and antiseptic drugs have been tried, most of them, perhaps, with a certain amount of benefit in some cases, but none of them exercising anything like a specific influence, and all of them liable to fail entirely. Sooner or later, in the absence of complications, the disease tends, of course, to get well, and only too often the particular drug which is then being given gets quite undeserved credit.

The oldest of the anti-spasmodic remedies is *belladonna* or, for older childen and adults, atropine. Children notoriously bear it well, at four or five years of age, often in doses fully as large as adults. Three minims of the tincture may be given quite safely every four hours to a child a year old. Trousseau, however, advised that the dose of belladonna, no matter how large, should only be given once a day, in the early morning, fasting. It sometimes seems to hasten the disappearance of the paroxysms and to cut short any tendency to their subsequent recurrence with an attack of bronchial catarrh, but during the height of the disease it may not uncommonly be taken until it causes dilatation of the pupils and dryness of the throat without any relief to the symptoms.

A more effective remedy is *cocaine*, but it has not hitherto been extensively used on account of the fear of dangerous consequences. It has been especially recommended by Russell Wells and Gerard Carré. They fix the dose at 1 gr. of the hydrochloride, three or four times a day, for an adult, and state that this is quite unattended by any risk. To a child of three months they give from $\frac{1}{16}$ to $\frac{1}{12}$ gr., to one of a year $\frac{1}{10}$ to $\frac{1}{8}$ gr., to one of three years $\frac{1}{5}$ to $\frac{1}{4}$ gr., and to one of six years $\frac{1}{3}$ to $\frac{1}{2}$ gr. They claim that under this treatment the whoop usually ceases in a fortnight, and that in the meantime the child's general condition improves, the sickness stops, sleep and appetite are better, and the cough becomes less frequent. During childhood there is no occasion to fear the acquirement of the cocaine habit.

Another sedative which acts in somewhat similar fashion to cocaine is *bromoform*. Perhaps the chief objection to its habitual use is its high specific gravity, nearly three times that of water. Consequently, being very insoluble and very difficult to emulsify, it tends to sink to the bottom of the bottle, so that the last dose of a mixture containing it may be a poisonous one, giving rise to coma, contracted pupils, and paralysis of the heart and respiration. Several such cases have been recorded and a few have proved fatal. To ensure complete safety the dose should at first not exceed ½ min. for children under one year, 1 min. for those under four, and 2 min. for those under eight. This quantity may be taken three times a day or oftener, and cautiously doubled. It is said to diminish the number and the severity of the paroxysms and to stop the associated vomiting. The following is a suitable way of prescribing it: ℞. Bromoformi, ♏48; Olei Amygdalæ Dulcis, ʒiv; mix and add Pulveris Tragacanthæ, ʒss; Pulveris Acaciæ Gummi, ʒjss; Aquæ Laurocerasi, ʒj; Aquam, ad ℥iij. One drachm contains 2 min. of bromoform. Even this emulsion should be well shaken each time before administration, and should be kept in a dark place, as bromoform decomposes in the light and is rendered useless. If expense is no object, advantage may be taken of the solubility of the drug in strong alcohol, and it may be prescribed thus: ℞. Bromoformi, ♏8; Alcohol (90 per cent.), ʒj; Tincturæ Cardamomi Co., ʒj; Glycerinum, ad ℥j. Dissolve the bromoform in the alcohol, then add the tincture and finally the glycerine. Two drachms contain 2 min. of bromoform.

Holt speaks very highly of *phenazone* (antipyrine) as the most efficient drug for whooping cough, provided it is given in rather large doses, about 1 gr. for each year of life, every three or four hours, up to four years. It may conveniently be combined with bromide of potassium or of sodium.

Quinine is regarded by some physicians as a valuable drug, especially towards the end of the illness, but its sphere of usefulness must be very limited, as the large doses required if it is to do any real good (1 gr. or 1½ gr. for each year of the child's life) are only too likely to upset the stomach of a young patient. Another drug which is sometimes used, by reason, doubtless, of its antiseptic properties, is *carbolic acid* in doses of ½ min. for a child a year old. Reference has already been made to its more frequent employment in the form of an inhalation.

Eustace Smith recommends a combination of *butyl-chloral* *hydrate* (1 gr.) and *bromide of potassium* (2 gr.), for a child of one year.

The cough is nearly always more troublesome in the night than during the day, and may sometimes interfere so seriously with sleep that special measures are necessary to check it. The drugs particularly useful for this purpose are: Codeine ($\frac{1}{60}$ to $\frac{1}{30}$ gr.), heroin ($\frac{1}{100}$ gr.), and opium in the form of tinct. camph. co. [U.S.P. tinct. opii. camph.] (5 min.), or Dover's powder ($\frac{1}{2}$ gr.). The dose in each case is for a child a year old. Any one of these drugs may be given at bedtime and repeated once, if necessary, during the night. Phenazone is also useful for the same purpose. Care should be taken to prevent draughts from reaching the child's face whilst in bed, as they tend to excite the attacks.

The repeated vomiting to which the cough often gives rise is in many cases the most troublesome and sometimes even dangerous symptom which calls for treatment. It may be so severe as to lead to profound inanition and thus predispose to a terminal pneumonic infection. The tongue, as a rule, is markedly furred, an indication of considerable gastric disturbance, which in its turn increases the frequency of the paroxysms. For such patients the diet should be most carefully regulated, small quantities of very digestible food being given at frequent intervals; Benger's food, meat juices or extracts, and milk, either diluted with lime-water or soda-water, peptonised, or citrated by the addition of 1 or 1½ gr. of citrate of soda to each ounce. According to Trousseau, solids are retained better than liquids; he also advises ½ or 1 min. doses of laudanum immediately before each meal. Cocaine may be especially useful for these patients, and sometimes also chloral, in doses of 1 gr. for a child a year old. In the worst cases in very young children whey only should be given for a day or two, and may be prepared with sherry wine in the proportion of 2½ oz. of cooking sherry to ½ pint of milk, as advised by Still. As far as possible food should always be given directly after a paroxysm, as a good deal may then be absorbed or passed on into the duodenum before another attack occurs. In fact, if when a meal is due the cough has not recurred for some time, it may be worth while to excite it by giving a little food and then to proceed with the meal as soon as the attack is over. The bowels should be kept regularly open, the combination of mercury and rhubarb, already mentioned, being especially useful so long as there is any furring of the tongue.

Vaccine Therapy.—Dr. John Freeman has treated cases of whooping cough with inoculations of a bacillus discovered by

Bordet, and which he believes to be the cause of the disease. Freeman states that so far he has obtained the best results with doses of from 80 million to 100 million of the bacilli, and that the average length of the disease among children so treated has been 4 to 3 weeks as compared with 7 to 4 weeks for the control cases, that is, patients treated on ordinary lines and given also subcutaneous injections of a little sterile salt solution, so that the mothers did not know that any differentiation was being made between the children. The vaccine injections did not give rise to any bad effects.

Treatment during Convalescence.—The most important point to bear in mind is the danger of the development of tubercle, a result either of diminished resistive power to infection or of the stirring into fresh activity of an old tuberculous focus previously latent. Tonics are necessary, especially iron and cod-liver oil, either alone or in one of the many preparations with malt. Caution must, however, be exercised not to begin these until the tongue is clean, or they may only increase and perpetuate a chronic gastric catarrh. During convalescence from all the acute specific fevers of childhood, parents, acting independently of medical advice, often do much harm by the premature and injudicious administration of preparations of cod-liver oil, Parrish's chemical food, etc. So long as the tongue remains furred it is better to give some such mixture as: ℞. Sodii Bicarbonatis, gr. 6; Tincturæ Rhei, ♏10 to 15; Tincturæ Nucis Vomicæ, ♏3; Spiritus Chloroformi, ♏3; Aquam, ad ʒij [U.S.P. ℞. Sodii Bicarbonatis, gr. 6; Tincturæ Rhei, ♏5 to 8; Tincturæ Nucis Vomicæ, ♏7; Spiritus Chloroformi, ♏3; Aquam, ad ʒij]; three times a day, a few minutes before meals, for a child three years old.

A change of air is very desirable in the later stage of convalescence; it hastens complete recovery and sometimes abruptly cuts short a still persistent whoop. The liability to catarrh must, however, be borne in mind, and no change made until all signs of bronchitis have disappeared. This is especially important when the weather is cold or changeable. When convalescence is not proceeding satisfactorily the throat should always be examined, and any adenoids or enlarged tonsils removed.

No description is called for here of the treatment of the chief complications of whooping cough, severe bronchitis and bronchopneumonia, as it does not differ in the least from that of the same diseases when they occur independently. It must be remembered that when these complications are present the whoop often disappears to return as they clear up.

The sub-lingual ulcers so commonly seen rarely cause any trouble, but, if necessary, they may be touched with mitigated nitrate of silver stick or painted with glycerine of carbolic acid.

J. WALTER CARR.

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CONSTITUTIONAL DISEASES.

AUTO-INTOXICATION.

These conditions, although not absolutely identical, are closely related to each other. It is only within recent years that as a profession we have come to realise the important part which abnormal chemical processes and the absorption of imperfectly prepared digested products play in the causation of disease. To Bouchard we are indebted for much that we know of auto-intoxication, or self-poisoning of the individual by products elaborated within himself. Bouchard's investigations gave a fresh impetus to the study of applied internal chemistry, which is not yet on the wane.

By metabolism is meant the chemical interchanges which take place in the various tissues of the body, and which in their final analysis resolve themselves into the formation of chemical compounds useful for the building up of the body. Chemical compounds too are evolved during the disintegration of animal cells. Cellular autolysis, therefore, participates in the process. It is not proposed to enter into a study of the recondite problems connected with the evolution and dissolution of cells. Maintenance of health and life depends upon the well-adjusted balance of bodily income and expenditure and upon the functional harmony of the various organs. A chemical flaw may arise during the processes of the elaboration of food material, in the processes of its reduction, and in the form in which effete materials leave the body. In metabolism the proteids, carbohydrates and fats taken as food meet their fate. These having been prepared by digestion for absorption and assimilation, and having played their part within the body, must be eliminated. Deficiency in quantity as well as imperfection of quality of the internal juices concerned in digestion may not only convert a painless into a painful process, but may give rise to abnormal products, the absorption and circulation of which through the body may act as poisons to the nervous system. Excess of materials essential to life may even become a source of danger. An overplus of water in the body owing to defective renal secretion may alter the conditions which regulate cellular osmosis: excess of mineral substances present in the food, such as sodium chloride, may produce a similar effect: increased production of, or a failure in the elimination of, cell ferments, which are essential to life, may become a cause of ill-health. After all, it is but a line which separates health from disease. Once nutrition has become disordered, new substances are formed which of themselves are toxic, and require for their elimination healthy emunctories. Were it not for the physiological resources of the organism man would be more frequently poisoned than he is. For health the functional integrity of the excretory organs is just as necessary as that of the organs concerned in the elaboration of food products. The intestinal canal is one of the most important emunctories. Absorption of toxins and poisonous gases from the intestinal canal is a frequent cause of headache, malaise, anæmia and of lethargy, the early recognition and treatment of which may rapidly translate a person from a condition of invalidism into good health. Physicians have many opportunities of becoming familiar with the extremely unpleasant odours which emanate from the skin of patients whose internal chemistry has gone wrong. Similarly, while the odour of the urine in health is not unpleasant, that passed by a person whose metabolism is perverted assumes qualities characteristic of the particular condition in question, as, for example, in diabetes. No study of auto-intoxication would be complete which did not take into consideration the part played by the lungs in the elimination of carbonic acid and other deleterious substances. The functions of the kidneys, skin and liver must not be overlooked. One of the principal sources from which auto-intoxication arises is the intestinal canal. The food eaten may have already begun to decompose, and the poisons thus generated may be absorbed from the alimentary canal. That an important part is played by micro-organisms in the intestines in health and disease is now generally admitted. Poisons such as those arising from acetic, butyric and lactic acid fermentation or such as leucin, a product arising out of the disintegration of proteids, as also such gases as sulphuretted hydrogen and ammonia, are all by-products of faulty digestion. The toxicity of the contents of the intestinal canal is always increased by anything which embarrasses the normal peristaltic movements of the canal. Constipation when persistent should be overcome by the use of a pill such as: ℞. Aloin, gr. 1; Ext. Nucis Vom., gr. 1; Ext. Hyoscyam., gr. 1; Ext. Coloc. Co., gr. 2, taken daily twenty minutes before dinner, and the dose lessened if the result is more than is desired. If there is fœtor of the stools, the use of intestinal antiseptics is called for. Intestinal decomposition must be prevented as far as possible, and towards this some of the digestive secretions render considerable assistance. It is always claimed for bile that it is more or less of an intestinal antiseptic. The salicylates of bismuth and soda are useful in stimulating the flow of bile, a remark which applies equally to calomel and grey powder in small doses. Bismuth salicylate darkens the stools, owing to the formation of the black sulphide of bismuth in the intestine and in the urine salicylic acid is found. Salol (in 5 gr. doses thrice daily, with or without bismuth) acts well. Bismuth nitrate is a mild antiseptic. One of the drawbacks to its use is that it causes constipation, but this can be to some extent remedied by the addition of magnesia carbonate. Beta naphthol (given in 1 gr. doses in pill form and taken thrice daily) also causes the stools to lose their fœtor. Charcoal is endowed with a similar power, and is useful where there is much intestinal gas present. Iodoform (in 1 gr. doses in pill form) is recommended by some physicians. Under the use of intestinal antiseptics Bouchard found that the urine lost its toxicity when injected into animals, a circumstance which shows that the drugs had been absorbed and had exerted a salutary influence upon the blood and body generally. Where the stools are persistently light-coloured, and the patient complains of headache, languor and an inability to apply himself to mental work, symptoms suggesting hepatic torpor, small doses of calomel or grey powder at night, followed by effervescing sulphate of soda in the morning before breakfast, or a pill of hydrargyr. c̄ coloc., are called for.

Dyspeptics as a class exhibit an irritability of temper and experience a sense of fatigue more than most people, symptoms largely the outcome of the absorption of products imperfectly elaborated during digestion. Patients who are the subjects of dilated stomach occasionally complain of severe cramp-like pains in the limbs which keep them awake at night. This condition, known as "gastric tetany," is a toxæmia, partly the result of the absorption of poisonous materials, probably alkaloidal in nature, from the stomach and partly the result of a dehydration of the cellular protoplasm of the tissues, caused by excretion of large quantities of liquid through the gastric mucous membrane into the stomach.

This with other disorders of metabolism, such as glycosuria, temporary and persistent, rheumatism and gout, are dealt with in other parts of this System, and for treatment may be referred to. In addition to these, mention may be made of myxœdema and acromegaly, the outcome of disordered internal secretions. Some of the diseases of pregnancy are intoxications, and are due to failure of elimination, while others are the result of deranged metabolism. More carbonic acid is eliminated by the gravid female than the unimpregnated. Opinions differ both as to the metabolic changes which occur in pregnancy and the extent to which the mother assists in building up the tissues of the fœtus in utero from materials drawn from her food and how far from materials supplied by her own tissues. It is a physiological fact that one tissue can be formed out of the materials of another. When, therefore, food is insufficient, there may pass over from the mother to the fœtus in utero a certain amount of maternal organised protein, or the building up of the fœtal tissue may be brought about by transference from the mother of absorbed food material, further elaboration of which can be accomplished by the fœtus, since it is the function of a developing organism to transform simple proteid material into the more complex organic molecules requisite for the tissues. According to circumstances, a mother may lose or gain weight during pregnancy. Van Noorden holds that if the same amount of food is supplied during pregnancy as previously, the mother retains less nitrogen for herself and the fœtus together, than for herself alone in the non-pregnant condition. She keeps losing nitrogen all through her pregnancy, and at the confinement there occurs rather suddenly a further loss of nitrogen, which lasts for a few days owing to the restricted diet and the lochial discharge. For disorders of metabolism and signs of auto-intoxication in pregnancy the medical attendant should be on the outlook. Among the earliest signs of toxæmia are headache and disordered vision. The urine should be examined for albumin, and, if found, the diet should be carefully regulated (*see* Pregnancy).

The menopause is in many women marked by the advent of certain symptoms, mental and physical, which, like flushings betokening a neuro-cardio-vascular derangement, have come to be regarded as specially characteristic of the period known as the "change of life." The close connection which exists between the ovaries and metabolism is shown by the tendency of many females to become obese, not only after the removal of these organs by surgical operation, but on the subsidence of their function after the climacteric. Further evidence of the relationship is shown by the pathological changes which occur in the bones in osteomalacia. After the removal of the ovaries from a patient suffering from this disease there occurs a striking improvement in health owing to the retention of phosphates within the body, whereby the osseous tissues regain their former rigidity. The metabolism of phosphorus is therefore materially influenced by the state of the ovaries, so, too, is the condition of the blood, since the removal of the ovaries in healthy animals is followed by a diminution in the number of red blood corpuscles and a fall in the hæmoglobin, both of which, however, are gradually recovered from. It is owing to the knowledge gained of the part played by internal secretions in the body, when such glands as the thyroid and ovaries are removed, that the modern treatment of disease by organo-therapy is so much in the foreground to-day. The relief to headache, flushings and nervous irritability obtained in some cases by the administration of ovarian juice, and the excellent results obtained in myxœdema by thyroid extract, are sufficient proofs of how the body suffers when internal secretions become defective.

THOMAS OLIVER.

ARTHRITIS DEFORMANS.

RHEUMATOID ARTHRITIS.

The existing confusion with regard to the nomenclature of the various types of arthritis deformans renders it essential that any discussion of their treatment should be prefaced by some attempt at exact definition of their pathological characteristics.

The term arthritis deformans is here used in a generic sense, comprising two main groups " rheumatoid arthritis " and " osteoarthritis." Under the first-named heading will be included not only the atrophic arthritis of Goldthwait, but also the more acute forms of rheumatoid arthritis, showing glandular and occasionally splenic enlargements. Pathologically, the morbid changes in this category occur primarily in the soft structures, the peri-articular and synovial tissues undergoing thickening with hypertrophy of the synovial fringes; while secondarily, a progressive atrophic change, involving all the constituent elements of the joints, takes place, including the bony and cartilaginous as well as the softer tissues.

As the foregoing pathological definition indicates, rheumatoid arthritis is a progressive wasting disease, and such being the case, it is obvious that a depletory mode of treatment is, with few exceptions, contra-indicated.

As to the pathogeny of the affection, it is now universally recognised that the condition is of toxic origin, and this view as to its genesis carries with it the inference that our first object in treatment should be the detection in the patient of any localised foci of toxic absorption.

Localised Foci.—In this connection it is essential that a most thorough examination of the mouth and its accessory cavities should be instituted. Carious teeth, when present, should be thoroughly cleansed and stopped, or, if necessary, extracted, and in patients wearing a dental plate one must not forget to look for decayed stumps under the plate. Only by the careful treatment of oral sepsis is it possible to prevent the constant infection of the lower levels of the alimentary tract by putrefactive anærobes ingested with food. The tonsils also demand attention, and their actual removal may, indeed, have to be considered, especially in those instances in which exacerbations of joint trouble have followed recurring attacks of tonsillitis. Similarly, the nasal cavities, with the antral and ethmoidal sinuses, must be carefully examined, as in several instances I have observed amelioration of the joint mischief to follow successful treatment of abnormal conditions in these regions. Aural discharges, when present, call for special local treatment. The genito-urinary tracts both in the male and female must not be overlooked as possible sources of toxic absorption.

While detailed examination on the lines indicated constitutes the primary step in treatment, it is obvious that the happiest results will only be achieved where detection and treatment of these localised foci are undertaken during the early stages of the malady. Where there are no definite indications as to the source of absorption, we have to resort to indirect means to improve the health of the individual.

Climate.—The ideal climatic surroundings for rheumatoid patients are a low relative humidity, abundant sunshine and a small rainfall; in other words, dryness and warmth. Damp surroundings and sudden fluctuations in temperature undoubtedly aggravate the affection, while the same may be said of long sea-voyages and residence by the seaside. High moorland districts are most suitable. A clay soil should be avoided, and preference given to sandy or gravel strata with little or no subsoil water.

If we except the wide diurnal range of temperature and the not infrequent presence of cold winds, residence in Upper Egypt and Algiers during the winter months possesses many advantages for these patients. Failing this, resort may be had to the French Riviera, the neighbourhood of Grasse being most suitable. The degree of crippledom or financial limitations in many instances renders residence in the British Isles compulsory. An inland bracing climate should then be advised.

Rest and Exercise.—During the acute pyrexial stages confinement to bed is advisable. Light splints may be necessary to ensure rest and diminish subsequent contractures; but the tendency to fixation is so marked that frequent passive movement is imperative, the splints being removed night and morning for this purpose. Light bed-clothing is desirable, and a cradle may be necessary to relieve the sometimes irksome pressure of the bed coverings. These patients must be got out of bed as soon as possible, and encouraged to use their joints in every way, otherwise incurable stiffness will inevitably ensue.

In chronic cases regular exercise short of fatigue must be insisted upon. Systematic movements should be undertaken : thus knitting, piano-playing, wood-carving and other manual exercises should be sedulously practised, so as to combat any stiffening and rigidity of the fingers. Especially is it important that the movements of pronation and supination of the forearm should be called into action by means of suitable exercises, such as opening of doors, uncorking bottles, etc.

For increasing the mobility of the shoulders the use of weights and pulleys is desirable, and where the knees are involved the daily use of a bicycle fixed upon an appropriate stand will be found most useful in restoring their mobility.

Finally, where exercise is impossible, the advantages of fresh air, sunshine, and change of surroundings must be obtained by the use of bath-chairs or other means of conveyance.

Clothing.—In acute cases the clothing should be warm but light; for this purpose a flannel nightdress, opening all the way down the front, should be worn. It is desirable that the sleeves should be loose-fitting, and well slit up along their outer side and fitted with tapes, thus permitting of ready access to the inflamed joints. In chronic cases woollen underwear is to be advocated. Shoes should be avoided, and properly fitting, laced-up boots of medium weight worn.

Diet.—Recent investigations have shown that in a judicious choice and variation of food-stuffs lies our most potent means of controlling the growth or modifying the character of the intestinal flora responsible for the abnormal putrefactive and fermentative processes associated with the gastro-intestinal derangements, which constitute an important factor in the production of rheumatoid arthritis.

During the acute stages of the disease milk should form the staple food. It should be given up to the limit of the patient's digestive capacity, and in those individuals who dislike plain milk, one of the prepared foods, such as Benger's or Mellin's, made up with this vehicle may be substituted.

Should there be definite evidences of intestinal putrefaction, namely, excess of indican and aromatic sulphates in the urine, a strict *regimen* of soured milk may be given a trial, but it should be abandoned as soon as a comparative degree of intestinal asepsis has been attained. If milk in any form is distasteful or unassimilable there need be no hesitation in supplementing or even replacing it by a liberal allowance of farinaceous foods. Thus carefully prepared thin oatmeal or barley-gruel, flavoured with nutmeg, or lemon-peel, or other spices, will often prove grateful to the patient. Arrowroot, prepared with or without milk, likewise milk puddings, such as rice, sago, tapioca, to which a tablespoonful of ground malt or maltine has been added, are often relished. This diet may be varied with custards and blancmanges made with gelatine. Where progress is tardy and unsatisfactory, this nitro-farinaceous regimen must not be enforced too rigidly, and a more varied diet containing clear vegetable soups, meat infusions, well-made julienne, raw meat-juice, mutton, veal and chicken broths, may with advantage be indulged in.

To restore the flagging energies of a patient exhausted by continuous fever a little whisky or brandy will be found serviceable in stimulating the appetite and assisting digestion. Fortunately in many of the acute cases remissions of temperature occur from time to time, and during these periods of enhanced assimilating power a more generous diet should be permitted, such as sweetbreads, oysters, lightly boiled fish of the more digestible kinds, as soles and whiting, also pounded and minced meats.

During convalescence the patient should be placed on three substantial meals a day, with an abundance of meat, and, if necessary, a reasonable amount of alcohol, preferably stout. In addition the ingestion of milk between meals, and during the night, should be encouraged, or, if preferred, Horlick's malted milk may be taken in its place.

It is highly desirable that fats, such as fresh butter, bone-marrow, fat bacon and suet, in the form of puddings, or cod-liver oil when assimilable, should be taken. A moderate quantity of all kinds of fresh vegetables is permissible, and they should by preference be taken in the form of purees, as this mode of preparation promotes their easy digestion.

Fruit, such as peaches, nectarines, apricots, fresh figs, and dates, may, when thoroughly ripe, be eaten raw. Cooked apples, pears, and plums of good quality may be taken in moderation. Oranges and lemons also may be eaten, and are of service in assuaging thirst in febrile patients.

Beverages, such as tea, coffee, cocoa, and chocolate, when of good quality and properly prepared, are suitable. Of alcoholic beverages, malt liquors are the most desirable, such as good stout. Failing these a good red wine, burgundy or a sound claret, may be substituted. If preferred, whisky or brandy, diluted with some mineral water, may be taken, but in all instances the amount consumed and the time of its ingestion should be strictly defined by the physician.

When gastro-intestinal derangements are present, these must be intelligently and perseveringly treated in accordance with their individual requirements, otherwise no improvement in the joint trouble is to be looked for.

The food eaten should be carefully selected, thoroughly masticated, and taken at regular intervals. The drinking of fluids should be postponed to near the end of meals, and then only taken in moderate amounts. Rest before and after meals should be enjoined, and a cheerful atmosphere as far as possible maintained during a repast, for "unquiet meals make ill digestions."

Medicinal Treatment.—The principles governing our selection and exhibition of drugs in this affection are based upon the assumption that the underlying condition is one of toxæmia.

As a counsel of perfection, doubtless, the administration of an anti-toxic serum would commend itself as the most direct mode of neutralising the offending toxin; but unfortunately all efforts hitherto made to this end have proved futile. Consequently we endeavour to achieve the same result in an indirect manner through the agency of certain drugs, which apparently possess the power of entering into some subtle chemical union with the peccant substances, and thus promote their more ready excretion. Among the various drugs which are presumed to act in this manner the following, in my experience, are the most reliable, namely, the sulphate, salicylate and hydrochloride of quinine, salol, and β-naphthol.

During the acute phases the sulphate of quinine (in gr. 2 doses, with ♏10 to ♏15 of hydrobromic acid) can be given every four hours, its frequency being reduced to three times a day when the general symptoms abate. Should symptoms of gastric derangement be already present or ensue, a cachet or mixture containing gr. 2 of salicylate of quinine, with gr. 10 of salicylate of bismuth, may be substituted. As an alternative, the hydrochloride of quinine (in gr. 5 to gr. 10 doses, with ♏30 to ♏40 of dilute hydrobromic acid) (Macalister) will sometimes be found more effectual.

In cases presenting symptoms of intestinal disorder the salicylate of quinine, in combination with salol (gr. 5 to gr. 10) or β-naphthol (gr. 2 to gr. 5), will be found useful.

For the relief of pain occasional doses of salicylate of acetyl (gr. 5 to gr. 10), with or without phenacetin (gr. 5), should be given a trial, and if sleeplessness should be a feature, a cachet containing one or other of the above analgesic remedies, with gr. 15 of bromide of sodium, will rarely fail to give relief. Seldom will it be found necessary to resort to opium and its derivatives. In cases marked by prolonged pyrexia, tepid or cold sponging will be found the safest and most certain means of dealing with this complication. A daily action of the bowels is imperative, and must be attained by means of mild laxatives, such as compound liquorice powder or the following pill: Aloin (gr. ¼ to gr. 1); Ext. Nuc. Vom. (gr. ¼ to gr. ½); Ext. Bellad. (gr. ⅛ to gr. ⅓) [U.S.P., Aloin, gr. ¼ to gr. 1; Ext. Nucis. Vom., gr. ¼ to gr. ½; Ext. Bellad. Fol., gr. $\frac{1}{12}$ to gr. ¼]. In cases of hepatic sluggishness, minute doses of calomel (gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$) every two hours until a grain is reached will be found beneficial, not only in stimulating the functions of the liver, but also in diminishing the tendency to intestinal putrefaction so common in these cases. The foregoing laxatives may from time to time be replaced by a morning draught of phosphate of soda (ʒj doses).

The same principles should guide us in the treatment of the chronic types of the affection, namely, the correction of abnormal putrefactive and fermentative processes in the alimentary tract, and in the absence of any such definite indications our efforts should be directed towards maintaining the general health at as high a level as possible.

While in my experience the salts of quinine are most useful in the acute phases of the malady, they do not appear to be of the same value in the afebrile types. Where gastric derangement is prominent, a trial should be given to carbolic acid (gr. 1 to gr. 3) and its derivatives. It is also in this class of case that guaiacol carbonate (gr. 3 to gr. 8), with or without iodides (gr. 5 to gr. 10), finds its chief sphere of usefulness. To ensure success it must be given for months. In cases attended by inactivity of the skin and subjective coldness, arsenic may be given in the form of arsenious acid (gr. $\frac{1}{50}$ to gr. $\frac{1}{30}$) in a pill or cachet. If nerve symptoms are prominent, it may with advantage be combined with a grain of valerianate of zinc, and $\frac{1}{4}$ grain of extract of nux vomica. In cases marked by pallor, emaciation and debility, Fowler's solution (♏ 2 to ♏ 5) may be combined with syrup of the iodide of iron (ʒss to ʒj) [U.S.P., ♏ 6 to ♏ 12], and cod-liver oil (ʒj) or the compound syrup of the glycero-phosphates (ʒj). In examples of the disease attended by coldness and asphyxial states of the extremities, I have frequently obtained good results with thyroid gland, commencing with doses of $1\frac{1}{2}$ grains three times a day, and gradually increasing the dose to 5 grains. Caution should be exercised in prescribing this drug, and it should only be employed under constant supervision. In conclusion, it must be understood that nothing in the nature of a specific drug has hitherto been discovered, and if success is to be obtained these cases must be treated on general principles, noting any indications for special lines of treatment as they present themselves in individual instances.

Local Treatment.—In the acute stages cold compresses may be applied to the affected joints, but in some instances an opium and menthol liniment will prove more soothing. Among other applications is a liniment composed of equal parts of guaiacol and olive oil, to which salicylate of methyl may be added. Should the odour of the latter be objected to, a combination of amyl salicylate and menthol made up with lanoline makes an excellent alternative. In chronic cases with much peri-articular thickening, gentle massage with the iodide and soap liniment will promote absorption. Other stimulating and anodyne applications are liniment of aconite, belladonna and chloroform in equal proportions.

Orthopædic and Surgical Measures. — The mal-positions resulting from contractures may be minimised, or even prevented, by means of light splinting, combined with frequent passive movements during the acute stage of the disease. Where fixation of joints seems inevitable, an attempt should be made to secure the limb in the most serviceable position, the knees being kept straight and the elbows and hips slightly flexed. Great care should be taken to correct any tendency to sinking of the plantar arch by the use of properly fitting boots, fitted with Holland arched instep socks.

For the relief of pain, consequent on distension of joints by effusion, aspiration, with subsequent strapping to prevent re-accumulation, may be practised.

In the knee, oft-recurring effusions, with symptoms of locking, should be treated by firm strapping before resorting to a removal of hypertrophied synovial fringes, as recently advocated. For the correction of vicious mal-positions, rectification by gradual extension is to be preferred to more forcible methods. Excision has been undertaken with varying success in the jaw and knee, while the mobility of the elbow-joint has been improved by resection of the head of the radius. For faulty position of the hip-joints, bi-lateral subtrochanteric osteotomy has been successfully performed. Finally, surgical interference, in view of the underlying pathological conditions, should be only undertaken in carefully selected cases.

Treatment by Natural Thermal Baths.—The special therapeutic value of hydrology consists in its acknowledged capability of ameliorating the effects or sequelæ of the disease. Patients should not be sent to a spa during the active stages of the malady, or until all foci of septic absorption have been treated as radically as possible. As a matter of experience the waters most suitable are those belonging to the acrato-thermal category, of which Bath, Buxton, Plombèires, and Aix-les-Bains are examples. While these waters are taken internally, their chief efficacy undoubtedly depends upon their external application through the medium of immersion, intelligently applied douching and massage. Used in these various ways the waters, apart from their general eliminative effect, restore the tone and diminish the spasm of the atrophied muscles, alleviate pain and incidentally, through the medium of massage and douching, promote the absorption of peri-articular thickening and check the tendency to ankylosis. A special form of treatment practised at Plombières, namely, intestinal irrigation, calls for mention by reason of its efficacy in ridding the alimentary canal of accumulated toxins.

On the other hand, the sulphurous and saline waters owe their efficacy to the remedial and sedative influence they exert on gastro-intestinal derangements, and the consequent diminishing of toxin formation in the alimentary canal. In this category the waters of Harrogate, Llandrindod, Llanwrtyd Wells, and Strathpeffer deservedly enjoy repute, their action being markedly enhanced by the tonic bracing character of the climates at these resorts.

Electrical Treatment.—For the relief of neuralgic pain the continuous current is of value, the positive electrode being moved slowly over the painful area. Apart from their favourable effects upon general and local metabolism, high-frequency currents are of use in diminishing articular and neuralgic pains in this disease. In cataphoresis we possess a valuable means of reducing articular swelling, pain, and stiffness. The halogens in highest repute for this purpose are chlorine and iodine.

Electric Baths.—The chief advantages of hydro-electric baths would appear to be referable to their tonic and invigorating effects upon the general system, hence their peculiar value in cases presenting marked nervous symptoms. Where total immersion of the body is for some reason inadvisable, the Schnee four-cell bath possesses obvious advantages for local or sectional application.

The non-luminous (Greville) and the radiant heat (Dowsing) baths, though highly commended by some authorities, have not in my experience yielded such encouraging results as those obtained through the medium of natural thermal waters.

Peat, Mud and Fango Baths, through their mechanical, thermic and possibly chemical effects, have been found useful in promoting absorption of exudates, reducing the stiffness of joints, and relieving pain.

Massage is an agent of distinct value not only in promoting nutrition of wasted muscles and in minimising contractures, but also through its beneficial effects on the circulation it facilitates the excretion of waste products and restores tone to the nerve centres. Passive movements and resistance exercises are useful adjuncts to massage, especially when the intelligent co-operation of the patient is secured.

Among **other special methods of treatment** must be mentioned Bier's treatment by hyperæmia, injections of fibrolysin and treatment by vaccines. Bier's method has been adopted chiefly for the relief of pain, stiffness and swelling; but even with the strictest attention to technique, the results, on the whole, have not been encouraging. Similarly with regard to the fibrolysin injections, general experience seems to point to their possessing only a limited sphere of usefulness.

Treatment by vaccines has up to the present been discouraging, but it is to be hoped that this rational mode of attacking the disease will before long be attended by a larger measure of success.

OSTEO-ARTHRITIS.

In this variety of arthritis deformans the primary changes are those produced in the cartilaginous and bony structures, which undergo enlargement or hypertrophy with the formation of osteophytic outgrowths, the synovial tissues being only implicated secondarily. Inasmuch as any views that may obtain as to the pathogeny of osteo-arthritis are largely speculative, it follows perforce that our treatment of the condition cannot be otherwise than empirical. The results obtained are sufficiently encouraging to warrant us in believing that, despite the immutable character of the anatomical lesions, much may be done by dietetic, hydrotherapeutic, and other measures to arrest or retard the march of the morbid process.

Diet.—In those rare instances of widely generalised osteo-arthritis, chiefly encountered in young subjects, an abundant and nutritious diet is indicated with no restrictions save such as personal idiosyncrasies may dictate. As opposed to this in localised types of the disease, more particularly those affecting the joints of the lower extremities, some modification of diet is often called for. Thus in those instances of osteo-arthritis of the knees, so frequently met with in women at the menopause, a tendency to obesity not uncommonly displays itself. The intimate bearing upon treatment of this mechanical factor, increased body-weight, becomes evident when we glance at the underlying pathological condition. It is obvious that during the natural exercise of any joint the seat of osteo-arthritis, the roughened cartilaginous surfaces and bony asperities must be a source of continual irritation to the sensitive synovial tissues. These articular structures in their turn show their resentment of these internal traumatisms by recurring synovial effusions, increased villous overgrowths and new bony proliferations, and a vicious circle is thus established. Such a state of joint irritability must of necessity be aggravated by the introduction of another factor, increased body-weight, throwing as it does additional strain upon the already harassed articulation.

Consequently, to attain any measure of success in the treatment of these cases, a reduction in body-weight, unless special contra-indications exist, must, if possible, be secured. To this end the carbohydrate and fatty constituents of the diet should be strictly limited, or even for a time wholly eschewed. Bread should be thoroughly torrefied and eaten but sparingly. Saccharin or saxin must be substituted for sugar, while the use of milk, cream, and butter should be avoided until a substantial decrease in body-weight has been attained. All forms of meat, game, poultry and fish may be freely taken, also clear soups such as plain Julienne. All vegetables, save the roots and tubers such as potatoes, may be eaten, but the inclusion of oil and beetroot in salads should not be permitted. No malt liquors are permissible, and in cases requiring alcohol, a very moderate quantity of a good sound whisky or some light wine such as dry hock or Moselle will be found most suitable.

A tumblerful of hot water with a slice of lemon should be sipped slowly either one hour before or two hours after meals for its flushing effects. The intake of fluids during meals should be limited, and that taken postponed until the end of the repast.

The foregoing modification in diet is chiefly indicated in those cases in which an obese habit of body has more or less suddenly ensued in persons the victims of osteo-arthritis in the lower extremities. Observation of the results obtained in a long series of such examples has convinced me that a restricted dietary forms an essential part of their treatment.

Medicinal Treatment.—This is frankly empirical, but hidden though their physiological mode of action may be, yet experience has shown that the prolonged use of certain drugs such as guaiacum, sulphur, iodides, and arsenic is frequently followed by amelioration of the articular troubles. If, however, any definite results are to be attained, the truth of the saying "Chronic diseases need chronic remedies" must be constantly borne in mind in regard to their exhibition.

In my opinion the most suitable and reliable drugs at our command for routine administration are guaiacum and sulphur, which, when given in combination, prove very useful in mitigating and in rare instances removing the muscular stiffness which is so troublesome a feature in these cases. To obtain their best remedial effects these agents must be given in doses adequate to produce a distinctly laxative effect. Usually 3 gr. of each, either in the form of a tablet or cachet taken three times a day after meals, will suffice, and only in rare instances will it be found necessary to exceed 15 gr. of each per diem. The iodides of sodium or potassium in 3- to 5-grain doses may advantageously be added to the foregoing combination when marked swelling and intra-articular effusion are present; or the stimulating and absorbent action of the iodine salts may be enlisted by means of cataphoresis, which I have found strikingly effectual in removing effusion.

In subjects of pallid aspect and dry skin, arsenic in the form of arsenious acid (gr. $\frac{1}{60}$ to gr. $\frac{1}{30}$) or arseniate of soda (gr. $\frac{1}{60}$ to gr. $\frac{1}{30}$) should be given a trial in the form of a pill three times a day.

In some instances of osteo-arthritis arising in women at or about the menopause, I have found the administration of thyroid gland serviceable. As I have stated elsewhere, the clinical facies presented by some of these patients is extremely suggestive of a variable degree of thyroid inadequacy, reminding one of the so-called *formes frustrées* of myxœdema, so graphically portrayed by Hertoghe. On this pseudo-rational basis I have frequently made tentative use of this substance, gradually increasing its dose from 2½ or 5 gr. daily to 15 gr. per diem. The results produced in some instances are very striking; but whether the amelioration is simply an indirect one referable to the diminution in body-weight incidental to thyroid ingestion, or due to some specific action upon the actual local lesions, is uncertain.

In widely generalised osteo-arthritis, whether occurring in young adults or senile subjects, it will be found wiser to rely upon the syrup of the iodide of iron (ʒss to ʒj) [U.S.P., ♏6 to ♏12], with Fowler's solution of arsenic (♏2 to ♏5), given in combination with cod-liver oil (ʒj) or the compound syrup of the glycerophosphates (ʒss to ʒj).

For the relief of pain in all forms acetyl salicylate (in 5-gr. doses) will be found the most trustworthy agent to employ.

Local Applications.—The most serviceable application we possess for the reduction of the unsightly nodosities of the fingers is some preparation of iodine, such as the liniment of potassium iodide and soap or the oleate of iodine.

Massage.—Massage, intelligently and perseveringly administered, will be found most serviceable in promoting the nutrition and diminishing the stiffness of wasted muscles, especially in the more localised forms of osteo-arthritis. Where the knees are the seat of the disease, the efforts of the masseur must be expended on the wasted extensors in order to restrain as much as possible the unbalanced pull of their antagonists, the hamstrings. Frequently no apparent wasting of the extensors exists, but notwithstanding, electrical testing will often demonstrate delayed reaction time, the change taking place especially early in the vastus internus. In cases of morbus coxæ senilis massage of the gluteal muscles must not be overlooked. Direct massage of the joints themselves should only be permitted when the joint trouble is quite quiescent, and then only performed with great gentleness.

Treatment by Baths.—Immersion in natural thermal waters is of considerable benefit both in the generalised and localised types, when combined with hot douching and massage. Vapour baths also are useful in cases characterised by inactivity of the skin, especially in patients unable to bear the higher temperatures attained in the Greville, Dowsing, and the more modern Tynraüer hot-air baths. It is, indeed, in osteo-arthritis rather than in rheumatoid arthritis that good results are to be obtained from hot-air or radiant heat baths. While these patients undoubtedly derive benefit from wintering abroad in warm and dry climates, yet the claims of well-equipped home spas should not be overlooked when financial circumstances or advanced age and feebleness forbid the undertaking of a long and tedious journey.

Orthopædic and Surgical Measures.—The various orthopædic measures practised in osteo-arthritis have for their object the protection of the affected joint or the limitation of its range of movement. Naturally such procedures can only retard the tendency to proliferation of the cartilaginous and bony structures, but the necessity of their employment becomes obvious in view of the important part played by so-called "internal traumatisms" in accelerating the disease. It is in the joints of the lower extremities that such mechanical aids are usually brought into requisition. When acutely inflamed, complete rest and fixation of the articulation is advisable, and subsequently a well-fitting kneecap should be worn during the daytime. In less severe instances firm strapping or bandaging may suffice to ensure the necessary protection and limitation of the range of movement of the affected joints. Patients who object to this restraint should be warned of the lamentable consequences that may follow neglect of this precaution. Aspiration for excessive synovial effusion is rarely called for, and arthrotomy for removal of hypertrophied villi is but seldom justifiable. Injection of sterilised vaseline into the knee and other articulations has in the hands of Buedinger been followed by improved mobility. The intrusion of bony spurs between the articular surfaces sometimes calls for operative interference, owing to the pain and recurring effusions occasioned thereby. Osteo-arthritic outgrowths, even when situated external to the joint cavity, may, through the pressure they occasion, call for removal. As to the excision of hip in inveterate cases of malum coxæ senilis, opinions differ, but more extended experience of this procedure is necessary before any certain estimate of its value can be arrived at.

SPONDYLITIS DEFORMANS.

In those rare types of arthritis deformans, whether of the atrophic or hypertrophic variety, in which the brunt of the disease falls upon the spinal column, care should be taken not to overlook any localised source of infection. In this connection it may be mentioned that a case of spondylitis deformans has been reported in which relief followed the detection and treatment of an infective focus in the ethmoidal cells. In another case pain and stiffness in the upper cervical vertebræ disappeared after antiseptic treatment of a decayed tooth. The possibility of gonorrhœal infection must be borne in mind, and, if detected, thoroughly treated.

Measures must be taken to maintain the patient's health at the highest level, such as abundance of good, nourishing food, combined with internal administration of arsenic, iodide of iron, and cod-liver oil.

Orthopædic measures should be taken early in the course of the disease, as only thus can the more distressing features of the affection be minimised, if not prevented. It is in the atrophic or rheumatoid variety that fixation of the spine is so urgently called for. For this purpose, in the milder cases, webbing or canvas belts or corsets will give the necessary support. In more advanced cases a plaster jacket may be fitted, and subsequently replaced by one of leather. The jacket should be applied without suspension. No force should be used, but the patient should stand as erect as possible while the case is being fitted. By these mechanical means the necessary rest for the spinal column is ensured; pain and muscular spasm are alleviated and the ultimate deformity diminished. The use of the jacket should be continued until the acuteness of the process has subsided, when a lighter form of corset should be adopted. A further advantage of fixation is that it tends to diminish the accentuation of the fixation of the curvature from muscular spasm, and thus corrects a certain measure of the deformity.

In cases of the osteo-arthritic variety of the malady attended by severe radiating pains, counter-irritation by blisters or the actual cautery should first be tried perseveringly. If these should prove ineffectual and X-ray examination reveals the presence of bony outgrowths encroaching on the neighbourhood of the nerve roots, the question of an operation to remove the osseous nodes causing the pressure symptoms will arise.

In all forms, when the acute stage is past, massage of the atrophied muscles should be practised, and may advantageously be combined with thermal treatment in the form of Aix massage. No attempt, however, should be made by forcible manipulation to correct deformity or to obtain more freedom of movement in the spinal articulations. Hot air and radiant baths may also be used at this stage of the disease.

In conclusion, the results of any form of treatment of the disease when advanced are so discouraging that the importance of early recognition with timely resort to the orthopædic measures above alluded to, cannot be too strongly emphasised, as in this way only can some of the more distressing features of the affection be minimised or possibly prevented.

LLEWELYN JONES LLEWELYN.

ON THE TREATMENT OF RHEUMATOID ARTHRITIS BY COUNTER-IRRITATION OF THE SPINE.

In the Lancet of 1901 (Vol. I., p. 998) I advanced the theory that the changes in the joints and the muscular wasting which are characteristic of rheumatoid arthritis are due to irritative and destructive lesions located in the spinal cord, and especially affecting the ganglion cells of the anterior horns of the cervical and lumbar enlargements; but extending also, when the disease is associated with "glossy skin," to the ganglion cells of the posterior horns. The grounds on which this theory was based are set forth in the article above mentioned, and were further amplified in a paper read before the Balneological Section of the Royal Society of Medicine on April 20th, 1910. This paper is printed in the Proceedings of the Society, Vol. III., p. 103, and also in the Lancet of 1910, Vol. II., p. 927.

Assuming this theory to be correct, the natural inference is that, in the earlier stages of the malady, and possibly also in cases of some standing, the treatment should be directed to the abatement of this spinal irritation, and this I suggest can be most effectively done by cupping or blistering the parts in the neighbourhood of the cervical and lumbar enlargements, and maintaining the counter-irritation for some ten days or a fortnight at a time.

The abstraction of blood by means of cupping glasses or leeches is rarely necessary. It may, however, sometimes be employed with marked benefit. In a paper by Professor J. K. Mitchell, On a New Practice in Acute and Chronic Rheumatism, which appeared in Vol. VIII., p. 55, of the American Journal of Medical Sciences, so long ago as 1831, he describes cases of chronic rheumatism and other arthritic troubles which were successfully treated in this way, the improvement being expedited in some cases by the subsequent application of blisters.

The following is the plan I usually adopt: Two cantharides plasters, 4 or 5 inches long by 2½ inches wide (painted over immediately before their application with linimentum cantharides or liquor epispasticus to ensure rapid action), are applied at bedtime, one on each side of the seventh cervical vertebra or the twelfth dorsal, according as the joints of the upper or lower extremities are most affected. The blisters are kept on for twenty-four hours. They are then removed, the loose cuticle cut away and a bread poultice, made with boracic lotion, applied for the night. In the morning the blistered surface is dressed with *freshly* prepared savine ointment spread on lint, and the dressing repeated every morning for eight to ten days. Each time before removing the lint it should be well soaked with boracic lotion, so as to prevent it from adhering to the blistered surface and causing unnecessary pain to the patient. I generally administer 20 drops [U.S.P. 12 drops] of laudanum the first night on applying the blisters, and if the joints are painful repeat the dose every night. If the joints both of the upper and lower limbs are affected, then seven or eight days after applying the blisters two more are applied, one on each side of the seventh cervical vertebra, if the two first have been applied to the dorsal region, and *vice versâ*, carrying out the same routine as before. The pain and swelling of the joints is generally much relieved in three or four days after the application of the blisters, even when no laudanum has been given, but the improvement is more marked both as regards the swelling and the pain when the narcotic is given. If the patient is suffering much pain, instead of the single evening dose, I give 10 minims [U.S.P. 6 minims] of laudanum together with 30 minims of the liquor hydrargyri perchloridi [U.S.P. hydrarg. chlor. corrosiv., gr. $\frac{1}{32}$] every six hours.

Whilst the counter-irritation is being carried out it is most important that the patient should have complete rest in bed, the affected limbs being moved as little as possible, especially if movement causes pain. At the end of eight or ten days the healing of the blistered surfaces may be promoted by the application of some simple dressing. The patient's general health must be attended to, the diet must be such as can easily be digested: beef, mutton, fowl, etc., with such alcoholic stimulants as are suitable. A daily action of the bowels must be ensured, to prevent the absorption of toxins from this source, and a proper amount of sleep must be obtained, if necessary by the regular administration at bedtime of opium or morphia. As the patient improves, massage, warm baths, radiant heat, etc., are important auxiliaries in the treatment, but on no account must massage be employed if it causes pain in any of the joints. As regards medicine, I have found the liquor hydrargyri perchloridi useful in doses of 1 drachm [U.S.P. hydrarg. chlor. corrosiv., gr. $\frac{1}{16}$] twice a day with some bitter infusion. Sometimes 3 to 5 minims of liquor arsenici hydrochloricus [U.S.P. liquor acidi arseniosi] may be combined with the perchloride solution with advantage, but it does not agree with all patients. No infrequently it may be necessary, especially in severe and chronic cases, to repeat the blistering process again after an interval of two or three months.

I would emphasise the fact that to ensure success the counter-irritation must be pronounced and prolonged—slight irritation is useless—and the irritation must be at the right spots, namely, in the neighbourhood of the cervical and lumbar enlargements. Applied, for instance, to the mid-dorsal region, it is useless. It is in the earlier stages of the disease that this plan of treatment is followed by the most satisfactory results. When the disease is advanced, the ends of the bones enlarged and the cartilages destroyed, one cannot hope to restore these to the normal condition by counter-irritation. Such a measure would only increase the patient's discomfort. Nevertheless, in chronic cases, where there are from time to time exacerbations of pain and swelling in some of the larger joints, the application of leeches or cupping glasses followed by the application of blisters to the spine is of use; the swelling and pain may be very quickly alleviated thereby, and the further extension of the disease arrested.

I need hardly say that it is of the utmost importance that before using cantharides or opium the condition of the kidneys should be carefully investigated. If they are unhealthy, this plan of treatment is absolutely unsuitable. The electric cautery in some cases may then perhaps be employed instead of the cantharides.

P. W. LATHAM.

DIABETES MELLITUS.

In health the sugar taken as food, or formed in the body from food or the tissues, is burnt to furnish energy, the end products, carbon dioxide and water, being excreted by the lungs, the kidneys and the skin. In diabetes mellitus this oxidation fails in a greater or less degree, with the result that sugar accumulates in the blood in a proportion larger than normal and is passed out into the urine. Harm follows in three ways: Firstly, because the presence of an excess of sugar in the blood and in the urine gives rise to symptoms which are distressing and may be dangerous, such as thirst, polyuria, with frequent micturition, eczema and other septic inflammations of the skin about the urinary outlet, and boils. Neuralgia, sciatica, retinitis and cataract are also regarded as the consequences of excess of sugar in the blood. Secondly, because the food value of the sugar excreted in the urine is lost, and, unless an equal value is added to the ordinary food supply in a form which can be oxidised, the body will be under-fed. Thirdly, harm follows because, if an excessive amount of fat has to be oxidised, as must be the case when sugar cannot be burnt, and especially when the under-fed body has to draw upon its own tissues for energy, the combustion of fat tends also to be incomplete, and unoxidised fatty acid accumulates in the blood and tissues. This fatty acid is more dangerous than sugar, for unless it is neutralised, or its formation checked, acid poisoning will follow.

The object of treatment, therefore, is also three-fold, namely, to reduce the amount of sugar in the blood and urine, to maintain nutrition, and to avoid acid poisoning.

The methods of treatment of diabetes mellitus may be discussed under the following heads: (1) Prophylaxis; (2) Dietetic and hygienic measures; (3) Medicinal treatment; (4) The treatment of coma; (5) The treatment of complications.

PROPHYLAXIS.

Diabetes is a disease that is apt to occur in families; it is commoner among people who are over-worked, subject to anxieties, and who live in cities than it is among those living quiet, orderly lives in the country. It follows that the children of families affected by diabetes or allied diseases, such as pulmonary tuberculosis or epilepsy, should not be sent to school early, pressed to pass examinations, or put to exacting city employment, but should be brought up as much as possible in the open air, and encouraged to some pursuit compatible with a regular, healthy, natural life. In middle age, those engaged in strenuous business, and inclined to fatness and to chronic arthritis, are disposed to become diabetic, especially if the disease has occurred in the family. Should suspicion arise, a full saccharine meal may be prescribed and the urine tested for sugar. If the test is positive it may be assumed that the power of absorbing or assimilating carbohydrate is diminished. The subject should then be recommended to eat moderately of bread, sweets and potatoes, though irksome restrictions need not be imposed in such a case. He should also be advised to avoid severe physical or mental fatigue. It is better for him to be content with a moderate income than to risk his health in obtaining a larger one.

DIETETIC AND HYGIENIC TREATMENT.

Two groups of cases must be distinguished from the point of view of treatment, namely, (a) those cases having dextrose in the urine, and (b) those cases having also diacetic or aceto-acetic acid in the urine, shown by the appearance of a brown or mahogany colour when a solution of ferric chloride is added. In the second group the diabetes is complicated by acidosis. β-oxybutyric acid is generally present also in much greater quantity than diacetic acid—there is often ten times as much—though no simple clinical test has yet been devised for it. Acetone, a derivative of diacetic acid, may be found as well. The test for diacetic acid is, however, so easy of application and so reliable that for clinical purposes it is sufficient.

(*a*) **Dietetic and Hygienic Treatment in Cases in which no Diacetic Acid is Found in the Urine.**—In a mild case of the first group the patient may complain of thirst, the passage of a large amount of urine, with frequent micturition, and perhaps irritation of the scrotum or vulva, or boils about the body. The urine is of a specific gravity of 1030 or more, contains dextrose, but no diacetic acid. The appetite is normal or increased. In many cases no mention is made of symptoms, sugar being found in the urine in a routine examination for some other complaint, or for insurance.

Other cases of slight and transient glycosuria are common, and should not be labelled diabetes unless dextrose is shown to be present in the urine on an ordinary diet. Fehling's solution may be reduced by other substances than dextrose, and not infrequently by uric acid in a concentrated urine.

A mild degree of acidosis may be present without the appearance of diacetic acid in the urine, and may be recognised by ascertaining the dose of bicarbonate of soda which will render the urine alkaline. In health 1 drachm of the salt will make the urine alkaline for twenty-four hours; but if acids are being produced in the body in excess, and passed out in the urine, larger doses are required. In severe diabetes, for instance, it may be necessary to give ounces a day for several days or even weeks.

The first step to be taken in such cases as we are discussing now is to order 1 drachm of bicarbonate of soda in a little milk three times a day; if the urine is alkaline in a day or two, we know that there is no considerable degree of acidosis. If a longer time or a larger dose is required, an excess of acid is being formed, and this is an indication that any alterations of the diet must be made gradually, with close attention to the urinary testing.

The second step is to find out how much sugar is passed out in the day. The urine of twenty-four hours must be mixed, measured and a sample analysed. The percentage of sugar alone is not an accurate guide, for it varies with the amount of fluid drunk or exercise taken. The calculation of the total amount in the day is easy if the urine is measured in cubic centimètres, and the analysis expressed in the number of grammes in 100 cubic centimètres. For example, a patient passed 3,400 cubic centimètres of urine in a day, containing 2·5 grammes of sugar in 100 cubic centimètres. The total sugar $= 2·5 \times 34·00 = 85$ grammes in the day. Grains per ounce involve more arithmetic, and give unwieldy total figures. If it is necessary to change one notation to the other it is accurate enough to regard a gramme as 15 gr., 1 oz. as 30 grammes, and a litre as 1¾ pints. The amount of sugar passed out is not constant from day to day, so that it is well to have analyses made for three consecutive days, and to take the average.

The next step is to reduce cautiously the sugar and starch in the diet. The immediate result of doing this is that the sugar in the blood and urine is lessened, as are the symptoms due to its excess, such as thirst, polyuria, eczema and boils. A further result, of more importance in the long run, is that the capacity of the tissues for oxidising carbohydrate is restored. The appearance of dextrose in the urine means that more sugar is supplied to the blood than can be burnt. If the blood and tissues continue to be flooded with sugar the power of burning it becomes still less, and more and more fat has to be used to provide energy, until the oxidation of fat also fails and acidosis follows. This is why untreated diabetics get worse. If, on the other hand, the carbohydrate supply is restricted, the tissues regain to a great extent their power of using sugar, with the result that nutrition is improved, and acidosis prevented or postponed. But the reduction of carbohydrate should be cautious and gradual, because if the patient is deprived of all starchy food he must be fed entirely upon protein and fat. Such a change of diet necessitates the oxidation of an extra quantity of fat, and, if made suddenly, is liable to set up acid poisoning, the very condition which it is desired to avoid. It is easier to cause the diacetic reaction to appear by restricting starch and sugar than to get it to disappear afterwards, even when carbohydrate is given in good quantity. We must, therefore, limit the diet in order to restore and maintain the patient's ability to use carbohydrate food, but so gradually as not to throw a sudden strain upon the metabolism of fat. In the majority of cases of this group it is possible to do this with success if the sugar is estimated and the urine tested regularly with ferric chloride.

It is necessary to know what foods are free from starch or sugar, and what proportions of these bodies are present in foods which contain them. In the following table common articles of diet are placed in three lists. The first is a list of foods containing no carbohydrate, or such traces as are negligible. The second is a list of foods containing carbohydrate in small proportions, and often containing so much of it in the form of cellulose that a good part is not absorbed, and passes out of the body in the fæces. The third list contains articles of diet which are rich in starch or sugar:

List 1.	List 2.		List 3.			
Foods free from Carbohydrate or containing less than 1 per cent.	Foods containing a low proportion of Carbohydrate.	Carbohydrate Percentage.	Foods Rich in Carbohydrate.			
			—	Carbohydrate Percentage.	—	Carbohydrate Percentage.
Beef	Liver . .	1	Calves' foot		Apples . .	14
Mutton	Sausage. .	1	. jelly	17	Apricots .	13
Lamb	Crabs . .	1	Meal .		Bananas .	22
Pork	Crayfish .	1	Flours .	70	Black-	
Poultry	Scallops. .	3	Rice .	to	berries .	11
Game	Asparagus .	3	Macaroni	80	Cherries. .	17
Sweetbread	Celery . .	3	Vermicelli		Cranberries .	10
Tongue	Cucumber .	3	Arrowroot .	97	Currants .	13
Fish	Lettuce . .	3	Tapioca . .	88	Chocolate .	30
Turtle	Spinach . .	3	Sago . .	78	Figs (fresh) .	19
Lobster	Oysters . .	4	Oatmeal	67	Grapes . .	19
Eggs	Mussels . .	4	,, (boiled)	11	Oranges .	12
Butter	Stilton cheese	3	Oatmeal (thin		Pears . .	14
Cheshire cheese	Cheddar ,,	4	gruel)	6	Pineapple .	10
American ,,	Rhubarb .	4	Rice (boiled) .	24	Plums . .	20

List 1—*cont.*	List 2—*cont.*		List 3—*cont.*			
Foods free from Carbohydrate or containing less than 1 per cent.	Foods containing a low proportion of Carbohydrate.	Carbohydrate Percentage.	Foods rich in Carbohydrate.			
			—	Carbohydrate Percentage.	—	Carbohydrate Percentage.
Dutch Cheese	Tomatoes	4	Macaroni (cooked)	16	Dried fruits,	
Gorgonzola ,,	Mixed pickles	4	Tapioca pudding	28	Apples	62 to 78
Lard	Cauliflower	5	Bread (white)	53	Apricots	
Gelatine	Cabbage	6	,, (toasted)	61	Currants	
	Leeks	6	,, rolls	56	Dates	
	Radishes	6	,, (brown)	47	Figs	
	Mushrooms	7	Gingerbread	63	Prunes	
	Water melons	7	Sponge cake	66	Raisins	
	Brazil nuts	7	Macaroons	65	Dried peaches	11
			Apple pie	43	,, pears	18
			Mince ,,	38	Chestnuts (fresh)	42
			Artichokes	17	,, (dried)	74
			Beet (fresh)	10	Cocoanuts	28
			Lentils (dried)	60	Almonds	17
			Onions (fresh)	10	Walnuts and filberts	13
			Parsnips	13	Carrots	9
			Peas, green	17	Strawberries	8
			,, (dried)	62	Turnips	8
			Potatoes	18	Milk	5
			,, (boiled)	21	,, (skimmed)	5
			,, fried, chips	47	Whey	5
			,, mashed with cream	18		

Analyses, Atwater and Bryant, Bulletin No. 28, United States Department of Agriculture.

It may be assumed that the patient has not entirely lost the power of using starch and sugar in the food, although he is unable to oxidise the full amount which he has been taking. In reducing the carbohydrate of the diet we shall probably be depriving him not only of the sugar which he cannot, but of some which he can, oxidise. We shall, therefore, be reducing the total heat value of his daily food. When it is remembered that in an ordinary diet half of the energy value of the food is derived from carbohydrate, it will be seen how great a risk there is of not giving enough when the starches and sugars are restricted. In order to avoid this risk the amount of food that a patient eats in a day may be put down and the heat value estimated from the tables given in my article on Dietetics in Vol. II. In the first of these tables, the heat value of a pound of the common articles of food will be found, and in the second one the weight of food in the form of an ordinary helping which gives 100 calories.

It is, however, difficult to make such a calculation with any accuracy unless the patient is attended by nurses who are trained in measuring and recording diets; and although this is desirable in some severe cases, we have a simpler clinical test of the patient's nutrition, namely his weight. Every diabetic should be weighed regularly by his doctor. If the patient is an obese, middle-aged glycosuric, there is no harm in his losing some weight, provided it is lost gradually; but in others a loss of weight is an indication that more food must be taken. Patients of balanced minds who are doing well and are likely to do well may be trusted to weigh themselves. There are many, however, who cannot be so described, and as a rule it is better for the doctor to do it, not only because an undesired fall of weight is depressing to the patient, but because slight variations of a pound or so, which often depend upon whether the rectum, the bladder or the stomach are full or empty, receive undue attention from an anxious patient, who is more worried by thinking over the loss of a pound than he is benefited by thinking over the gain of it on the next day. Patients are also apt to weigh themselves too often.

In prescribing a diet we should always allow the patient as much bread as possible. This food is missed more than any other, for the bread substitutes, valuable as they are, do not replace it. The patient is more likely to follow instructions if they are lenient. If he is treated too strictly at first he will tire of obedience, and if it is necessary later to place him upon a really strict diet for a time, he will be less inclined to carry out the directions given. Some patients suffer restrictions with comparative ease, in others very great self-control has to be exerted, and this should earn the sympathy of the doctor. Before drawing up the diet we should ascertain from the patient and his friends what his habits have been in regard to carbohydrate food; whether he has been a big bread eater, and taken cakes, puddings and sweet things freely. If so, the restriction at first may be less severe.

In the cases we are considering now all the food in lists 1 and 2 may be allowed. Measured quantities of bread, milk, and gruel, and, perhaps, some other food, may also be allowed from list 3.

For instance, a patient passing 180 grammes of sugar in the day is allowed Lists 1 and 2, with ½ pint of milk for tea and for gruel. We may allow him at first the same amount of carbohydrate in the food as is passed out in the urine, that is, 180 grammes, though we should not allow him more than 180 grammes if he were passing out more sugar. The carbohydrate may be made up as follows, taking an ounce, fluid or solid, as 30 grammes. Bread should be eaten dry and may be taken then at 60 per cent., and boiled potatoes at 20 per cent., of starch.

We must add some estimate of the amount of carbohydrate that will be taken in with the foods allowed in List 2, and in the gruel, assuming that each food is taken in ordinary helpings, as in the scheme of meals laid out below. This figure may be put at 20 to 30 grammes.

Diet I. contains foods from Lists 1 and 2 and

			Carbohydrate grammes.
10 oz. (= 300 g.) of milk	(5 per cent. carbohydrate)	=	15
6 ,, (= 180 ,,) ,, bread	(60 ,, ,,)	=	108
4 ,, (= 120 ,,) ,, boiled potatoes	(20 ,, ,,)	=	24
3 ,, (= 90 ,,) ,, apple	(14 ,, ,,)	=	12
Estimate of carbohydrate in foods from List 2		=	25
Total carbohydrate			184

No sugar is allowed, no puddings or dishes made with flour, and no jam. Saccharin may be used to sweeten tea or coffee if desired, but it is better to acquire the habit of drinking them unsweetened, for much saccharin becomes distasteful and is apt to upset the digestion.

Such a diet may be distributed as follows:

Breakfast.—A basin of thin gruel made with 5 oz. of milk; 3 oz. of bread; butter, bacon, eggs; a tomato; coffee with cream.

Lunch.—Meat or fish, pickles, 3 oz. of potatoes, butter, greens; green salad with salad oil; 1 oz. of bread, with cheese and celery.

Tea.—2 oz. of bread, with abundance of butter, a boiled egg; tea with cream.

Dinner. — Soup, containing no flour; fish, meats, 1 oz. of potatoes, spinach; custard made with cream and sweetened with saccharin; cheese; butter, with Protene or Callard's starchless bread; 3 oz. of apple; a few Brazil nuts.

The patient must not be asked to take the same diet day after day. From the lists above it is easy to supply alternative articles of food. The amounts allowed of the foods which are limited must, however, be adhered to. It is unpleasant for food, such as bread, to be weighed at the table, but this may be done on a letter-scale outside the room or at a side-table. The eye soon learns to estimate the amounts approximately, but it is desirable when any accurate observations are being made to use the scales.

Meats, fish, eggs, butter, dripping, fat bacon, should be taken freely in one form or another, so that the patient may become accustomed to make them the basis of his diet.

When the patient has been for three to seven days on this diet the mixed urine of twenty-four hours is analysed again. If there is a marked reduction in the quantity of sugar, the diet should be continued for another week and another analysis made, and so on, as long as the sugar in the urine is falling.

If there is little or no reduction of the quantity of sugar, or if, having fallen, it is rising again, the carbohydrate should be reduced by 50 grammes. This may be done by omitting 2 oz. of potatoes and 2 oz. of bread, leaving the diet otherwise the same. This **diet (II.)** will then contain foods from Lists 1 and 2, and—

	Carbohydrate grammes.
10 oz. (= 300 grammes) of milk	= 15
4 ,, (= 120 ,,) ,, bread	= 72
2 ,, (= 60 ,,) ,, potatoes	= 16
Carbohydrates in foods from List 2	= 30
Total carbohydrate . .	133

During each restriction of carbohydrate it is well to give sodium bicarbonate until the urine becomes neutral or alkaline to litmus, when it may be omitted if there is no diacetic reaction.

If after five days on the above diet the sugar is still present in quantity, the next restriction is to omit the potatoes and 5 oz. of the milk, and to cut down the articles in List 2, allowing only well-boiled greens and a tomato.

The **diet (III.)** then contains foods from List 1, greens and a tomato from List 2, and—

	Carbohydrate grammes.
5 oz. (= 300 grammes) of milk	= 7
4 ,, (= 120 ,,) ,, bread	= 72
Estimate of foods from List 2	= 10
Total carbohydrate . .	89

At this stage, or before, it will be necessary to provide some bread substitute in the form of the starchless bread made by the Protene Company, Callard, and others, of which the patient should be encouraged to eat freely with abundance of butter.

Upon such a diet as this many diabetics do not lose any sugar in the urine. If, however, there is still a definite quantity—for instance, more than 20 grammes—passed out in the day, the bread may be reduced by half, in which case the **diet (IV.)** will consist of foods from List 1 and—

	Carbohydrate grammes.
Milk, 5 oz.	= 7
Bread, 2 ,, ...	= 36
Estimate of foods from List 1 . .	= 10
Total carbohydrate . . .	53

If the urine is not sugar-free after five days of such a diet the bread should be omitted for three days, and be replaced by an unlimited quantity of one of the substitutes. At the same time, sodium bicarbonate should be given, and, if there is hunger, 1 gr. of opium in the day.

In the milder cases we are considering, the urine will now become free from sugar. As soon as this is the case, the allowance of carbohydrate should be increased. It will be found that after a period of strict diet it is possible to give more than before without causing or increasing glycosuria. That is to say, the power of assimilation for that foodstuff is to some extent restored. The restoration of this power should be the main object of the dietetic treatment of diabetes. Provided that the amount of sugar in the blood, and, therefore, in the urine, is kept at a low level, it is more important to increase the quantity of carbohydrate that is assimilated than it is to get rid of all the sugar in the urine; hence if carbohydrate is added to the diet we want to know not only whether there is more sugar in the urine, but how much more in comparison with that added to the food. For instance, if a patient on a strict diet is passing 40 grammes of sugar a day, and on allowing 4 oz. of bread the amount rises to 60 grammes, then we know that of the 72 grammes of starch in 4 oz. of bread 52 were assimilated and 20 added to the unoxidised sugar in the urine. The patient is the gainer by 52 grammes of carbohydrate, which will give him over 200 calories of energy, as each gramme of starch furnishes 4·1 calories.

It must not be supposed, however, that there is a fixed amount of carbohydrate which a given patient can assimilate, for there are often daily variations, the causes of which are not ascertained. Certain influences may be mentioned here. One of these is the kind of carbohydrate. Some patients will assimilate levulose better than dextrose; some will use one kind of starch, such as that of oatmeal or the potato, more completely than another kind, such as that of bread. The aim of the doctor is to find out what kind suits his patient best and in what quantity it can be used. Having discovered this, a diet should be prescribed which contains the maximum amount that can be assimilated.

Regular analyses must be made every few days in the early weeks of the treatment, but when the most suitable diet has been found it is sufficient to have the sugar estimated and the urine tested for diacetic acid on two or three consecutive days once a month. The patient should be advised in his own interest to live during the testing days in the same way as regards diet and exercise as on the other days of the month.

In all classes of diabetes mellitus the patient should be allowed to satisfy his *thirst*. No good effect has been shown to follow restriction of fluid, nor is it to be expected, since the thirst is due to the polyuria associated with the excretion of sugar. Water is the best drink. Aërated waters and the sugar-free lemonade, ginger ale and lime juice may be taken, and weak tea and coffee. The use of alcohol is referred to on p. 428.

The *hygiene* of the milder cases may be considered under the headings of fresh air, muscular exercise and mental work.

The house should be as light and well ventilated as possible. An outdoor existence is most beneficial. The symptoms will often disappear during a restful holiday in a warm climate. Exposure to wet and undue cold must be avoided, for the diabetic is prone to intercurrent diseases, especially of the lungs. The clothing should be loose and for the most part woollen. Occupations and sports which involve special risks of injury ought to be avoided. Regular muscular exercise, preferably out-of-doors, is to be recommended in moderate degree for all mild cases, but never to the point of fatigue. Routine mental work is not harmful, and it is advisable for the patient to continue his occupation and his ordinary interests in life. But mental anxiety and worry accelerate the progress of the disease; hence occupations involving repeated strains, especially to do with money matters, should be modified if possible, even if a smaller income be the result. In the majority of cases of the mild type the disease may be kept under control if the subject can live a simple healthy life with moderate restrictions of the diet.

(*b*) **The Dietetic and Hygienic Treatment of Cases in which Diacetic Acid is Found in the Urine.**—When the urine gives the test for diacetic acid, it commonly also contains β-oxybutyric acid and acetone. The presence of these bodies indicates that the amount of carbohydrate which can be burnt by the tissues has fallen so low that fat has to be oxidised with excessive rapidity to supply the needs of the body, with the result that its combustion is incomplete. It has also been suggested that a certain amount of carbohydrate is essential in man to furnish energy to the cells which have to do with the metabolism of fat. It has been found that unless about 60 grammes of carbohydrate are being burnt per day the above-mentioned fatty acids appear in the urine, and are found in the tissues. This condition of acidosis would speedily lead to fatal acid intoxication did not the body possess means of neutralising the excess of acid: firstly, by giving up the bases calcium, magnesium, potassium and sodium from the tissues; and, secondly, when this supply fails, as it soon must, by providing the base, ammonia, which would otherwise have been passed out as urea. Very large quantities of ammonia may be excreted daily, combining with, and in a large measure neutralising, the fatty acids.

In these conditions the object of treatment is two-fold: first to limit and reduce the production of the fatty acids by increasing the amount of carbohydrate assimilated; and, secondly, by furnishing alkali to assist the neutralisation of the fatty acids still produced. If the acidosis is unchecked it will in the end, unless some intercurrent disease forestall it, lead to coma.

The steps to be taken in the management of the patient are the same in principle as described above in the account of the treatment of the milder forms, but differ in that all dietetic changes must be made with greater care, especially as these are cases in which it is often necessary to impose an absolutely starch-and-sugar-free diet for a few days at intervals.

The degree of acidosis should be estimated as before by finding out the quantity of sodium bicarbonate which is necessary to render the urine neutral or alkaline. It will be much greater here than in the milder cases. From ½ oz. a day, up to 2 or 3 or even more ounces are required in some cases for a few days. It is surprising how well the stomach bears such quantities when the acidosis is severe. Alkali must be given during the changes of diet also. If a patient is placed upon a strict diabetic diet without alkali, the appetite fails within a few days, and nausea, pain in the abdomen, constipation and often drowsiness appear. These symptoms are due to aggravation of the acid poisoning, as Beddard, Pembrey and the writer have shown, and are the initiatory symptoms of diabetic coma. They pass off commonly, but they may not do so; hence there is a risk of inducing coma when a diabetic of this class is placed without due precautions upon a strict diet. With this warning in mind, diets will be prescribed as above containing lessening amounts of carbohydrate. By the time diets III. and IV. are reached we shall know whether the urine responds by a fall in the amount of sugar; we shall also have an estimate of the amount of carbohydrate which can be assimilated. If there is still a considerable quantity of sugar with these allowances of carbohydrate, a strict diet, as below, may be prescribed for a few days. To make the meals palatable, the diabetic marmalade, biscuits, cakes and milk made by Callard, the Protene Company and others must be freely used, the diet being made up of the articles of food in List 1 and of these products.

Diet V.—*Example of a Protein and Fat Diet containing Traces only of Carbohydrate.* Foods from List 1, and special "diabetic" foods.

Breakfast.—Bacon and eggs; starch-free bread, butter; sugar-free marmalade; coffee with cream.

11 *a.m.*—Half a pint of sugar-free milk; diabetic biscuits with butter.

Lunch.—Fish, a lobster, starchless bread, butter and cheese; sugar-free ginger ale, lemonade or lime juice, or whisky and water.

Tea.—Tea with cream; two boiled eggs with starch-free bread and butter; diabetic biscuits and cakes.

Dinner.—Clear soup, meat, poultry or game; egg custard made with cream and sweetened with glycerine; starch-free bread and cheese; beverages as at lunch.

It is essential that large amounts of meat and of fat should be taken if the needs of the body are to be supplied on this diet.

After a day or two the sugar, if any, persisting in the urine is entirely derived from the tissues and not from the food. Such a strict diet as the above should not be ordered for more than a few days. Its advantages for a short period are that the last grammes of sugar that can be controlled by diet are got rid of, and the power of assimilating carbohydrate is improved. At the end of the period the vegetables of List 2 should be added first; afterwards it will often be found that a measured quantity of ordinary bread, or of potato, or of oatmeal, may be allowed without affecting the excretion of sugar and with good effect on the acidosis. The permanent diet to be prescribed for a patient of this class would depend upon the severity of the case; in a patient passing out diacetic acid regularly in fair quantity, and excreting sugar on the strict diet, it would probably consist of diet IV. (p. 415), which contains 50 grammes of carbohydrate, with one day of strict diet (V.) in each week, and three consecutive days of the same every fourth week. On the second and third of these three days the urine would be collected and analysed, as well as on two ordinary days in the month on which diet IV. is being taken.

In this kind of case the doctor must always be prepared to put the nutrition of the patient and the risk of acid poisoning before the dietetic regulations connected with the amount of sugar in the urine. If the patient is losing weight and cannot manage to eat any more protein or fat, an increased allowance of oatmeal, potato or bread should be given and the effect carefully watched;

if the loss of weight is arrested, the allowance should be continued.

In such a case it is of value to estimate the total N in the urine by Kjeldahl's method, and compare the figure obtained with the intake of N in the food, which may be calculated from tables, subtracting 1 gramme for that passed out in the fæces. A loss of nitrogen is unfavourable and should be met at once by a more liberal diet. Weintraud reports that in these circumstances the nitrogen balance is improved if less meat is given and more fat.

Every case of diabetes must be considered by itself and treated on its merits. Any hard-and-fast plan of treatment will prove harmful to some of the patients to whom it is applied. Treatment most suited to the individual case cannot be arrived at without exact urinary examinations and measured diets. The ideal plan is for patients to be under daily medical control for a month with analyses of the urine. The suitability of different articles of food to the particular patient and his assimilative power can then be ascertained.

A warning may be given here about the estimation of sugar. The results obtained by Fehling's, Pavy's and the cyanide methods may easily be far from the truth in unskilled hands. The most accurate of these is Pavy's method, if properly done; but it has the disadvantage that the inexperienced worker, especially if in a hurry, may obtain a figure which is only a half or less of the right one without knowing of his error, and may repeat the analysis two or three times with the same result. A reliable plan is to have the sugar in the urine estimated gravimetrically by an analytical chemist.

A further warning refers to diabetic foods. It cannot be assumed that these are sugar-free unless they are made by a reputable firm, and even then it is wise to have them analysed occasionally. Starch-free imitations of bread are costly to make, and sell at an enhanced price; there is, therefore, a great temptation to the unscrupulous to substitute other products for them. I have had a sample of flour "recommended for diabetes" brought to me which contained over 50 per cent. of starch. Again, a patient travelling abroad sent me a sample of "almond bread for diabetics" which was more than half starch; and some gluten bread, advertised in France as containing less than 5 per cent. carbohydrate, contained 30. A bread which is honestly stated to contain a definite but reduced amount of starch may be very useful in diabetes. For instance, in the dry matter of the Brusson Jeune bread, one-fifth was found to be carbohydrate. If, therefore, a patient is allowed, say, 2 or 4 oz. of ordinary bread, he may take instead double that quantity of this product without adding to his intake of starch. Such a bread is inadmissible, however, for a strict diet. Fromm & Co.'s "Unibrot" was found to contain 7 per cent. of carbohydrate in the fresh sample. Some analyses of Callard's breads gave

Brown bread,	2·2	per	cent. of	carbohydrate
Sponge cake,	2·8	,,	,,	,,
Biscuit,	5·8	,,	,,	,,

These are the percentages in the dry matter, so that in the fresh product there was still less; indeed, a negligible quantity. The above analyses were made in the laboratory of Mr. J. A. Gardner, Chemist to St. George's Hospital.

The successful dieting of the patient will really depend on the cooking. It should be impressed on the relations that fat in some form must be incorporated with the foods, especially with any potatoes or vegetables that may be allowed. Sauces containing flour cannot, of course, be allowed, but the starch-free flour of Callard or the Protene Company may be used instead. Saccharine and glycerine are valuable substitutes for sweetening food. Levulose sugar may be employed for patients who assimilate levulose better than dextrose. The makers of sugar-free foods supply little books of recipes which will be found useful. All possible skill and thought must be employed to give the diet variety and to keep up the appetite, for it is essential for the patient to eat freely to make up for the want of carbohydrate in the food.

Many forms of treatment or "cures" have been praised, but, so far as I am aware, in none of them has genuine success been attained unless regulation of the diet has been included in the "cure."

The **oatmeal treatment** advocated by v. Noorden may be used, and is said to be most valuable in patients under middle age. Slight cases in older people need not be submitted to such a routine, and for severe cases, and those complicated by nephritis, it is unsuitable. Before ordering the diet, the urine is freed from sugar as far as possible by the dietetic measures described above. Eight to 10 oz. of oatmeal porridge are then given every two hours; during the day 6 to 8 oz. of butter, and either 3 to 4 oz. of vegetable protein, such as casein, or five to eight eggs are prepared in various ways, and added to the dietary. Black coffee, tea, lemon juice, and a little wine or diluted spirits are allowed. This diet is continued for three or four days, and is followed for one or two days by a diet containing abundance of vegetables; for instance, spinach, tomatoes, cucumbers, cauliflower, asparagus, salads, with butter, bacon, five or more eggs, mineral waters or half a bottle of claret. After two days 6 to 8 oz. of fish are added, and if sugar is not increased, 6 oz. of meat, and later cheese and cream. The patient then returns to the original diabetic diet. The rotation of diets should be repeated more than once if necessary. It has been shown that in many cases good has followed this treatment, the diacetic acid and acetone in the urine being diminished in a short time, and even the sugar, in spite of the large amount of carbohydrate in the oatmeal, of which as much as 9 oz. a day are used in the porridge. No other kind of carbohydrate should be given upon the oatmeal days, and no meat. If diarrhœa comes on, a few drops of laudanum may be ordered four times a day. Œdema may occur, and is treated by v. Noorden with theophyllin (theocin): not more than 6 to 9 gr. should be given in the day, as an excess of the drug is reported to cause indigestion, vomiting and diarrhœa. The oatmeal cure is like the "milk cure" and the "potato cure," in that only one kind of carbohydrate is allowed. It is reported, however, in successful cases to give better results, especially in the great reduction of acetone bodies in the urine, as is of course, to be expected if the oatmeal starch is utilised.

The *hygienic directions* in regard to housing and fresh air are the same as in the milder types. The occupation and family circumstances must be considered in every case. Any sudden change of occupation or habits may have a bad, and in the severest cases even a disastrous, effect. Those who are able to choose their place of residence should be advised to live a quiet, country outdoor life, but it is better for those who have to be in a town every day for their work to be near it than to tire themselves by travelling a distance to and from the country. As a rule, no hasty change should be made in the daily customs of the sufferer, except in the direction of removing sources of anxiety and fatigue. Long journeys should be taken in easy stages, or, better still, not taken at all. Meals should be at regular hours. Contact with tuberculosis should be avoided.

The effect of exercise must be observed with care in each case of this type by noting the amount of sugar in the urine, the weight and the general condition on exercise days as compared with rest days on the same diet. In some, moderate walking, cycling or rowing leads to diminution of the excretion of sugar, and is a valuable help to the combustion of carbohydrate; riding is a good form of exercise, the appetite being increased with less muscular work than with walking and most out-door games. On the other hand, some patients, especially the ill-nourished, do not bear muscular work well. In severe cases dry friction and short periods of massage may be beneficial.

MEDICINAL TREATMENT.

Alkalies are more useful than any other medicine in the treatment of most severe cases. They act by neutralising the excess of acid formed in the tissues, and, as already described, are used in the diagnosis as well as the treatment of acid poisoning. The smallest dose to be used is 1 drachm two or three times a day, but ½ oz. in the day will often be required to make the urine alkaline, and occasionally several ounces a day for a short time. The bicarbonate of soda is the most convenient form, and may be given in a little milk, if milk is allowed, or if not, in mineral water; it should be discontinued, or the dose reduced, when the urine has been made neutral or alkaline. Indigestion may follow the administration, and in some cases œdema of the legs. The sodium is passed out in the urine as sodium oxybutyrate and sodium aceto-acetate, the diacetic acid reaction being much increased.

It has been suggested that other bases than sodium ought to be supplied to replace those lost in the urine in diabetes, especially calcium, potassium and magnesium; but the potassium and sodium of the blood and the calcium of the bones are spared by the administration of soda, and it has not been shown to be of so much importance to replace these bases as it undoubtedly is to neutralise the excess of acid. Both objects may, however, be served by ordering a mixture of sodium and potassium bicarbonates, with a small quantity of calcium and magnesium salts, instead of sodium bicarbonate alone.

Alkali, as described in the section on the Treatment of Coma, may also be injected into a vein, but not into the subcutaneous tissues or sloughing will follow.

Diabetes is a disease in which **alcohol** may be expected to do good, for alcohol is a carbon compound which can be oxidised to furnish energy, and can replace an equivalent quantity of carbohydrate or fat in the food. The poisonous effects of this drug must not, however, be forgotten, especially in severe diabetes in which the resistance of the tissues is lowered; an excess has been known to bring on coma. Alcohol has been shown to lessen the excretion of the acetone bodies though seldom that of sugar. Distilled spirits are, of course, free from sugar, and are to be recommended on that account: 1 oz. of whisky well diluted twice a day is a suitable prescription. Sugar-free wines are also prepared, and may be used in moderation at meals. Wine has the advantage that it often enables the patient to take his meal better, a point of importance when the diet is restricted and tends to be unappetising.

Opium is of great value, but especial attention to the avoidance of constipation during its administration is necessary. Opium is not directly anti-diabetic, but acts through the nervous system by diminishing hunger and thirst, and thereby limiting metabolism, with the result that the amount of both sugar and of urine is lessened to some extent. It is especially valuable if neuritic pains and insomnia are present. v. Noorden recommends its use when the sugar has been reduced as far as possible by diet, but not for more than a fortnight at a time: ½ gr. twice a day is commonly efficient. **Codeine** may be used instead of opium with advantage.. Dr. Pavy advised ½ gr. three times a day, the dose being gradually increased until 4 to 6 or 8 gr. are being taken a day. Neither opium nor codeine is likely to produce much effect unless the diet is regulated.

Good results are described from the administration of **aspirin** in doses of 15 to 45 gr. a day for two or three weeks at a time, when the sugar has been reduced by diet.

Sodium Salicylate may be used in the same conditions.

Arsenic may be given with benefit in many patients.

***Zyzygium* Jambulanum** has been praised, and v. Noorden gives it a qualified approval, but states that he has never seen good follow its use unless the diet was also controlled.

Any diuretic drug or drink, though not affecting the total excretion of sugar, will lessen the percentage in the urine; a fact which has proved very useful to the vendors of fraudulent cures.

COMA.

In severe cases any sudden worry, anxiety, mental strain, physical fatigue, as that of a long journey, or any change in the habit of life, such as being confined to bed, is liable to bring on coma. Every effort should, therefore, be made to ensure quiet equable surroundings for the patient.

Diabetic coma, once established, leads to speedy death in the majority of cases. Infusion with 2 or 3 pints of a solution of 3 per cent. bicarbonate of soda or of normal saline often brings about a return of consciousness for a few hours, only to be followed by fatal relapse. This treatment should, however, always be applied, and should be followed by 1 drachm of bicarbonate of soda in 5 oz. of water or mineral water every hour by the mouth, for there is a minority of cases in which infusion with alkali has more lasting results. Several instances have now been recorded of patients who have lived for months, and even returned to their occupations after recovery from coma. Success is more frequent when the signs of acid intoxication which threatens to be fatal are recognised at a stage earlier than that of coma. These signs are pain in the abdomen, obstinate constipation, nausea, drowsiness and air-hunger. The last-named is the most significant.

In every severe case not doing well the chest should be exposed and its movements watched; if each respiration is expansive, showing that a larger quantity of air than usual is being breathed in and out, and if other signs of severe acidosis are present, then the patient is in risk of immediate coma. Sodium bicarbonate should be ordered at once in doses of 3 drachms every two hours until the urine is alkaline. If the drowsiness increases, 3 pints of a 3 per cent. solution should be injected into the median basilic vein. The bowels must be opened by enema and by castor oil or blue pill, and the limbs kept warm. A light fluid diet should be given containing carbohydrate in such forms as milk, potato soup and oatmeal gruel, and anything else in reason which the patient may desire.

After recovery from coma, or from threatened coma, carbohydrate food should be allowed freely for a week or ten days, and then should be restricted, but not severely, the urine being kept neutral with alkali.

COMPLICATIONS.

The dietetic measures appropriate to the disease will aid in the cure and usually prevent the recurrence of those complications which are due to an excess of sugar in the blood, such as boils, carbuncles, eczema, neuralgia and retinitis. In addition, each complication must receive its own proper treatment.

Pregnancy.—R. Lepine recommends that in the early months the usual hygienic and general treatment for diabetes should be followed, but no drugs given. If the patient gets worse the uterus should be emptied. If diabetes is discovered in the last three months, treatment will again depend upon its severity, labour being brought on at once if the disease is grave. The labour of a diabetic should be terminated as soon as possible, and the utmost care taken to prevent sepsis. Repeated labours involve great risks in diabetes.

Boils and Carbuncles are fomented with antiseptic lotions and pus is let out. General anæsthesia should be avoided, if possible.

Eczema and Pruritus in the regions exposed to contact with saccharine urine are treated by a dusting powder, and the parts sponged with a saturated solution of boric acid at least twice a day. The skin of the whole body must be kept scrupulously clean by a daily tepid bath or sponging, ointment being applied if any signs of inflammation appear.

Retinitis may disappear when the patient comes under dietetic control.

Neuralgia and Sciatica often pass away also when the disease is treated; they are afforded immediate relief by bromide of potassium or by opium.

Should **constipation** be obstinate, the patient is instructed to take regular exercise, if his condition allows, to make a daily attempt at defæcation at a fixed time, and to eat plenty of fatty foods and green vegetables. If there has been no motion for two or three days, castor-oil or calomel should be ordered at once. For regular use v. Noorden recommends a powder of 15 gr. of rhubarb, 7 gr. of bicarbonate of soda, and 7 gr. of sulphur, in a cachet on retiring. A saline draught every morning is often successful of the formula: Sodium sulphate, 30 gr.; magnesium sulphate, 30 gr.; sodium bicarbonate, 10 gr.; sodium chloride, 1 gr.: one or two teaspoonfuls in ½ pint of water to be sipped on rising. In severe cases constipation precedes the onset of coma, and must be treated without delay.

Diarrhœa is less frequent, but may be dangerous. It may sometimes be checked by a change of diet. Chalk, tea, or the decoction of hæmatoxylin should be prescribed, and the patient kept thoroughly warm and quiet.

Nephritis.—Simple albuminuria coming on after glycosuria has been established for some time does not call for special treatment. If definite nephritis is present, however, the diet must be modified, for in this condition a strict regime is not well borne. As much carbohydrate as possible must be allowed, with plenty of fat, so that the protein intake and the work thrown on the kidneys are lessened. Milk may be given in increased amount in preference to other forms of protein-containing food.

Perforating Ulcer should be treated as described under that heading, general anæsthesia being avoided, if possible.

Diabetic Gangrene.—If dry gangrene appears, the part should be carefully dressed to avoid infection occurring; no operation is to be recommended.

Moist Gangrene, however, demands immediate operation, whether acidosis be present or not. The risk of general anæsthesia being succeeded by coma may be minimised by a procedure described recently by A. E. Johnson (Brit. Med. Journ., Vol. I., April 2nd, 1910). The anterior crural and sciatic nerves were exposed under local anæsthesia and novocain solution injected into them. General anæsthesia was then induced for eight minutes by nitrous-oxide gas and oxygen, while amputation through the thigh was performed.

E. I. SPRIGGS.

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DIABETES INSIPIDUS.

THE polyuria of diabetes insipidus must be distinguished from that of diabetes mellitus, of granular kidney, of hysteria and of hydronephrosis. In diabetes insipidus the urine is of low specific gravity, the water of the urine being increased in quantity, but the solids in slight degree only or not at all. A little sugar may be present occasionally, but not enough to raise the specific gravity of the urine. In polyuria due to diabetes mellitus the specific gravity of the urine is high and sugar is present, the quantity of urine being roughly proportional to the amount of sugar. In granular kidney, albumin is found in the urine, and the heart and blood-vessels present changes. In hysteria the polyuria is not of long duration; in hydronephrosis it is intermittent.

Prophylaxis.—The onset of diabetes insipidus cannot usually be foreseen. The disease has been observed to follow a bout of alcoholic indulgence, injuries to the head, sudden chills from bathing in cold water or drinking a large quantity, and distress or anxiety. It is sometimes hereditary, and is said to be more likely to occur in families affected by glycosuria, albuminuria, tuberculosis, gout and syphilis. In such, therefore, the above-mentioned stresses and shocks should be avoided so far as possible.

Treatment.—The restriction of fluid does not affect the course of the disease, the thirst being secondary to the secretion of such a large quantity of water by the kidneys. If the water drunk by the patient is greatly limited, the specific gravity of the blood rises above normal; that is to say, the output of water exceeds the intake. A moderate limitation, however, during which the amounts of water taken and of urine passed are measured, may be of benefit so long as it is accompanied by a corresponding reduction in the quantity of urine, but no longer: dehydration of the tissues must be carefully avoided. Highly spiced food, causing thirst, and salt, which causes both thirst and diuresis, should be omitted from the diet.

Electricity has been beneficial in some cases, and may be applied to the medulla and to the kidney. One electrode may be placed in front of the cervical spine through the nostril, and the other to the back of the neck, a current of ½ to 5 milliampères being used; or the anode placed on the nape of the neck, and the cathode first on the loin and then on the epigastrium. For the kidneys faradism or galvanism may be employed, the current being passed from the loin to the hypochondrium, first over one kidney and then over the other.

Out-door exercise should be recommended to patients not suffering from great weakness.

Of medicines, valerian, atropine, bromides, ergot and codeine are recommended. Valerian may be prescribed as the powdered root, beginning with 5 gr. three times a day, and gradually increasing the dose until 2 to 3 drachms are taken daily, or as follows: Ammoniated tincture of valerian, ½ oz.; aromatic spirit of ammonia, 20 drops; chloric ether, 20 drops. Sig.: To be taken every six hours in a wineglass of water. Or valerianate of zinc may be ordered in doses of 1 to 2 gr., rising to 20 gr., or even more, three times a day. In cases complicated by insomnia, Ralfe recommends the addition of 10 drops [U.S.P. 5 drops] of tincture of cannabis indica, and 30 gr. of bromide of ammonium, to the prescription given above, half a dose being taken twice a day and a full dose on going to bed. Atropine does not affect the secretion of urine in health, whilst if the dosage is pushed, it gives rise to thirst. I have nevertheless seen its use lead to diminution of the symptoms in diabetes insipidus. The solution of the sulphate may be given or the tincture of belladonna, the latter, for instance, in a dose of 5 drops three times a day.

It is probably better to avoid codeine and opium, except perhaps in the very acute forms, for the disease is one which may last for years. Indeed, in some cases the health seems to be but little affected. Phenazone may be given in 8 gr. doses every two to three hours, increasing the dose with great caution up to 60 gr. in the day. Other drugs which have been employed are arsenic, strychnine, turpentine, phenol and nitro-glycerine. For the headache and lumbar pains, salicylates may be of value. In syphilitic cases the appropriate treatment should be applied and controlled by the Wassermann reaction. The most favourable cases are those arising in middle life and those due to a head injury which does not permanently damage the brain. In acute cases, especially in children, the outlook is not good.

E. I. SPRIGGS.

GLÉNARD'S DISEASE (ENTEROPTOSIS).

GLÉNARD'S DISEASE, or enteroptosis, occurs in both complete and partial forms. Many cases are of obscure origin. Apart from the displacement of the viscera, which is best remedied by some form of mechanical support, there are frequently secondary symptoms of varied nature, but chiefly connected with the gastro-intestinal functions, often with varying grades of neurasthenia.

Mechanical Support.—This is most conveniently and effectually remedied by a properly made corset, which should be so constructed as to press the viscera upwards and to apply firm pressure to the hypogastrium and the lumbar regions. In many cases this is all that is required. After a time, the abdominal musculature having regained its normal tone, the wearing of such a corset may be discontinued. It is important to see that the corset when applied fulfils these conditions and that the patient is able to keep it suitably adjusted.

General Treatment.—This will depend to a large extent on the special conditions obtaining in each case. A period of complete rest is of great benefit in some instances. In cases of sluggish habit exercise is indicated. Abdominal massage is often of the greatest benefit as it tends to combat the sluggishness of the abdominal venous circulation. Respiratory and gymnastic exercises are frequently of advantage. Many of the patients are thin and poorly nourished and a liberal dietary is then beneficial, especially if it leads to a more normal deposit of fat in the abdomen. On the other hand, the gastric and intestinal musculature is often atonic and constipation should be met by the free use of laxatives, preferably natural mineral waters. Strychnine is useful for its tonic effect on the musculature. Alcohol should be avoided altogether.

W. H. MAXWELL TELLING.

THE SURGICAL TREATMENT OF ENTEROPTOSIS.

THE question of operating for this condition should not be considered until non-operative treatment has been given a thorough and prolonged trial. Those operations which aim at anchoring the prolapsed organs in their normal positions by means of sutures usually fail, as it can hardly be expected that a few sutures will permanently sustain heavy organs such as the stomach and colon against the force of gravity which tends to drag them into the pelvis. When the abdominal wall is lax or the recti are separated an operation to repair the abdominal wall is a sound procedure and is worth performing in suitable cases.

Although it is seldom possible to treat directly the condition by operative means, we can sometimes relieve the more serious symptoms by operation. Thus, one of the factors which causes most trouble in severe cases of enteroptosis is stagnation of the fæces in the dependent transverse colon and consequent auto-intoxication. This, if serious, may be relieved by appendicostomy and daily irrigation of the colon. This operation has been performed in these cases several times with gratifying results.

Other operations which have been performed are: (1) Suspension of the transverse colon by sutures to the abdominal wall; (2) shortening of the gastric ligaments; (3) excision of the colon.

As has been said, operations depending upon suspension of the parts by sutures have usually failed and are not worth performing. They afford no certainty of relief, and often, by damaging the abdominal wall, render the condition even worse than before.

P. LOCKHART MUMMERY.

GOUT AND GOUTY CONDITIONS.

GENERAL PRINCIPLES ON WHICH THE TREATMENT OF GOUT IS BASED.

In the first place it should be borne in mind that no routine treatment can be adopted which is suitable to all cases. The nutritional condition of the patient, his habits, surroundings, and mode of life constitute factors that must necessarily modify the treatment of individual cases, and with gout, as with so many other diseases, it will be found that each individual case requires separate study, and frequently special treatment. Quite apart from the treatment of an attack of gout, which is a comparatively simple and easy matter, we have to consider the treatment of the condition or conditions which led up to the attack. In connection with this point it must be remembered that the gouty individual is one whose general metabolism is unstable, and that this instability may be present in one or more of the great physiological systems, the digestive, the nervous, the circulatory, etc. The question which of these systems is primarily and mainly at fault should always be a matter for patient investigation, and an endeavour must then be made to improve the metabolism of that system by suitable medicinal, dietetic and hygienic treatment.

The treatment of gout should have for its aim the following objects: (1) The treatment of the gouty paroxysm in cases of acute gout and the relief of the pain as speedily as possible; (2) the treatment of the subacute or the chronic condition and prevention of the recurrence of an attack; (3) the treatment of the affected joint or joints with the object of removing the uratic deposits and of preventing permanent deformity; and (4) the treatment of the various forms of irregular or abarticular gout.

TREATMENT OF ACUTE GOUT.

In order to arrest the abnormal intestinal fermentation, to remove the excessive numbers of intestinal bacteria and to relieve the catarrh of the intestinal mucosa, all factors in the development of abnormal intestinal toxins, the bowels should be freely opened with 4 gr. of calomel or " blue pill," followed by a saline aperient. For the first twenty-four hours it is preferable that no food should be taken, but water should be drunk freely.

For the treatment of the gouty paroxysm the limb should be placed in the horizontal position or slightly elevated above the level of the body, and a cradle should be arranged so as to take the weight of the bedclothes from the affected part. To alleviate the severe pain felt in the affected joint warm packs should be arranged round it, consisting of cotton-wool saturated with a soothing lotion, and then lightly covered with oil-silk. I have found the following lotion most useful in relieving the local pains: Sodii Carb., ʒij; Linim. Belladonnæ, ℥ij; Tinct. Opii, ℥ij; Aq., ad ℥viij.

A small portion of the lotion should be mixed with an equal quantity of hot water and then poured on cotton-wool previously arranged round the joint. The pack should be changed every four hours. In connection with the acute paroxysm no attempt at local depletion, such as the application of leeches to the inflamed joint, blistering, or incisions, should on any account be made, owing to the great liability of thereby extending the inflammatory condition and so producing subsequent ankylosis or deformity.

For the internal treatment of acute gout colchicum is one of the most valuable drugs that we possess. It should especially be used for acute gout and for subacute attacks supervening on chronic gout. If it is used continuously, tolerance is apt to be acquired, and then the drug ceases to act. At the commencement a large dose of 30 to 40 min. of colchicum wine should be given, followed by a mixture containing in each dose 15 to 20 min. of the wine, with from 40 to 60 gr. of citrate of potassium, which should be administered three times a day. The citrate of potassium, which is given for its combined properties of acting as a diuretic and of diminishing the acidity of the urine, may, if desired, be given as an effervescing mixture, using 30 gr. of potassium bicarbonate to 20 gr. of citric acid. Colchicum reduces the gouty inflammation, relieves the pain, and shortens the attack. It should only be taken under medical advice, and should never be given in such doses as to produce extreme depression; after the inflammation of an acute attack has subsided the doses of colchicum should be gradually diminished until the drug is left off. A very useful method of administering colchicum is in the form of its active principle, colchicine, which may be given in doses of $\frac{1}{80}$ to $\frac{1}{50}$ gr. three or four times a day immediately after food. Only a few patients will tolerate doses of $\frac{1}{50}$ gr., the contra-indication of such a dose being the production of diarrhœa and internal griping. The following constitutes a very useful pill: Colchicinæ, gr. $\frac{1}{80}$; Ext. Nucis Vom., gr. $\frac{1}{4}$; Ext. Hyoscyami, gr. $\frac{1}{2}$; Ext. Gentianæ, gr. 1.

After the initial free purgation, as previously mentioned, it is not desirable to produce too free an action of the bowels. All that is necessary is to have a sufficient action to relieve portal congestion and intestinal catarrh. The following pill effects this purpose in most cases very well. It is administered at night, and is followed up, when necessary, by a dose of saline in the morning: Leptandrin, gr. 1; Iridin, gr. 1; Ext. Hyoscyami, gr. 1; Ext. Colocynth Co., gr. 2.

If the pain of an acute attack of gout is so severe as to prevent sleep, 7 gr. of veronal or 10 gr. of trional may be given, or a full dose of extract of hyoscyamus will, in some cases, act as a very useful anodyne. The administration of opium or morphine should, if possible, be avoided, owing to the risk of its deficient elimination and also on account of its diminishing the amount of urine and its tendency to derange digestion and to check hepatic metabolism.

Diet in Acute Gout.—As previously mentioned, it is preferable that no food be taken for the first twenty-four hours of an acute attack of gout, but water should be drunk freely. During the acute attack the patient should be restricted to a milk diet, which may consist of milk, bread and milk, and tea made with boiling milk instead of with water. Weak tea with cold toast thinly buttered may also be taken. The free drinking of hot or cold water, of Salutaris water, or of some simple mineral water, should be encouraged. The milk diet should be continued until the acute inflammation is subsiding. This stage is indicated by the lessening of the pain and by the pitting on pressure of the affected parts. No alcohol in any form should be given during this stage unless there are strong reasons for its administration, such as a weak action of the heart and a feeble, irregular pulse, when a little well-matured whisky diluted with Salutaris water will prove the best form of alcohol. Beef-tea and any of the meat extracts or essences should be avoided at all times by gouty patients, owing to the tendency they have to irritate the kidneys and to the fact that they are loaded with waste nitrogenous products. With the subsidence of the acute attack the patient may return to a more liberal diet, but care should be taken to avoid anything indigestible. The dietary suitable for gouty subjects after the acute attack has subsided is fully dealt with under the heading of Diet in Gout.

TREATMENT OF SUBACUTE AND CHRONIC GOUT.

In addition to colchicum, which may be given in small doses, guaiacum may very usefully be administered as an alterative which stimulates the metabolism of the liver and also affords relief to the portal system. From 5 to 10 gr. of guaiacum resin should be given in cachets two or three times a day, according to the effect on the bowels, since guaiacum sometimes acts as a laxative. The method of administering the powdered guaiacum resin in cachets is far preferable to giving the tincture of guaiacum in a mixture, as, in the latter form, a nauseous medicine is produced, and the precipitated resin tends to cling obstinately to the tongue and fauces. In cases of chronic gout the colchicum may be very conveniently administered in the form of the colchicine pill, given three times a day. In order to encourage the elimination by the kidneys of the toxic agents of gout, citrate or bicarbonate of potassium should be employed as a diuretic, as it increases the volume of the urine, and at the same time diminishes its acidity. The use of the potassium salt may with advantage be pushed until moderate alkalinity of the urine is produced, as by such means the tendency to the deposition of uric acid or sodium biurate in the kidney tissues is removed. Free diuresis should also be encouraged by the drinking of sufficient quantities of water. Of the beneficial effects of employing a potassium salt in conjunction with colchicum in the treatment of acute and subacute gout I am fully assured, and my experience is that of the various potassium salts the citrate is the most useful. If given in sufficiently large doses, it tends, by its conversion in the kidneys into the carbonate, to diminish the acidity of the urine, which is generally high in connection with the gouty paroxysm, while, at the same time, it increases the solvent power of the urine for the uric acid salts and so assists their elimination. In cases of sluggish action of the liver, of gastro-intestinal catarrh and torpor, of gouty dyspepsia, and of other forms of irregular gout, in which there are no appreciable uratic deposits in the joints, mineral waters containing sodium salts are undoubtedly beneficial owing to the action of those salts as hepatic and gastro-intestinal stimulants.

As regards the use of lithium salts in the treatment of gout, my opinion is that they are not so useful as the potassium and sodium salts. The principal objection to their use is their greater toxicity and depressing action on the heart as compared with the potassium salts. They consequently have to be given in such small doses that I am very doubtful whether, in such doses, they possess any remedial effect at all. On the other hand, I constantly meet with patients suffering from cardiac depression and even dilatation as the result of the excessive and continued consumption of lithia tablets, which are so persistently, so speciously, and so wrongly vaunted as curative of gout.

The enlargement and tenderness of the gouty joints is due to two causes, the deposition of sodium biurate in the cartilages and fibrous structures and a chronic inflammatory thickening of the fibrous tissues. For the reduction of this thickening, as well as for painful gout of the sole of the foot and for gouty neuralgic affections, iodide of potassium given internally is a useful remedy. In cases of gout associated with the contracted granular kidney, as evidenced by slight albuminuria and high arterial tension, the administration of iodide of potassium is also most beneficial. I usually prescribe it in doses of 10 gr. three times a day, and continue its use over a period of six or eight weeks. My experience is that it seems to act more beneficially when given in combination with the compound decoction of sarsaparilla.

In the treatment of the gouty state associated with disturbance of the functions of the liver, the most important consideration is the restoration of that organ to its normal state of activity, and here the alkaline sodium salts are especially useful. There is no better treatment at the outset than a dose of blue pill or calomel at night, followed by a dose of Epsom salts or Carlsbad salts in the morning. Subsequently a pill containing a small dose of "blue pill" or calomel combined with euonymin and colocynth will be found most useful. In such cases of gouty hepatic inadequacy a mixture which I have found most beneficial as regards its stimulating effect on the metabolism of the liver, and also of the gastro-intestinal tract, is one containing sodium bicarbonate, gentian and nux vomica, taken a quarter of an hour before meals.

The indulgence in high living by gouty subjects induces arterial plethora and a rise of blood pressure. The consequent strain on the arterial walls produces arterial disease if continued long enough, but in the early stages of such rise in blood pressure the administration of "blue pill" and careful attention to diet will always prevent the incidence of arterial disease. Gouty subjects are more prone to the injurious effects of constipation of even a slight degree than non-gouty individuals.

So-called "Solvents of Uric Acid."—Uric acid cannot be "washed out" of the system. Substances that dissolve uric acid in the test tube are of little or no use in increasing the output of uric acid in the body. When drugs do increase or diminish the uric acid excretion they act by directly affecting the cellular processes of the body and not by dissolving out the uric acid deposits. In no case is there a possibility of converting the uric acid in the deposits into a more soluble condition by the addition of potassium or lithium salts. The only possibility of converting a sparingly soluble urate into a more soluble compound is to remove the primary uric acid ions from the solutions. That can be done by the addition of strong alkaline solutions which convert the primary uric acid ions into secondary ions; but that is obviously a method inapplicable in therapeutical practice.

Some years ago a solvent of uric acid seemed to have been found in urea. It was apparently shown by Rudel that a water solution of urea, as well as urine, would dissolve very considerable quantities of uric acid or urates. One litre of a 2 per cent. urea solution was said to dissolve at the normal temperature about 0·5 gramme of uric acid, and a 10 per cent. solution more than 2 grammes, while a litre of water dissolves only 0·0253 gramme. Moreover, compounds of urea with uric acid were said to have been isolated, and these observations excited much interest in regard to the treatment of gout and stone formation. Careful repetition of Rudel's experiments has, however, led to directly opposite conclusions, and it may be confidently stated that urea does not affect the solubility of uric acid in water. Neither does its presence in a water solution sensibly counteract the separation of uric acid from its salts. Nor have any compounds of uric acid and urea been obtained. Consequently, since urea has no influence upon the relations of solubility and equilibrium of uric acid or its salts, the proposed treatment with urea is destitute of any scientific foundation.

I have deemed it advisable to make no reference to the employment of any of the numerous preparations which are so constantly being introduced to our notice as infallible solvents of uric acid and as specifics for gout. It is not that I have not made trial of them, but such trials have always led to disappointment, and have sent me back with renewed confidence to the drugs of our Pharmacopœia. I have witnessed, and doubtless shall again witness, the rise and fall in popularity of many a so-called solvent of uric acid, which has been introduced with exaggerated praise and with the usual undeserved laudation born of insufficient experience.

Preventive Treatment.—After convalescence, as much exercise as possible, short of fatigue and discomfort, should be taken in the open-air. Cycling is an excellent exercise for the gouty, since it furnishes good muscular movement in the open-air without the gouty joints having to bear the weight of the body.

I have now had a considerable experience of the prophylactic effects of guaiacum resin, and I must confess that I know of no drug which is more useful in the preventive treatment of gout.

Its action is probably due to its stimulating effect on intestinal and hepatic metabolism. The form in which I prefer to give it is that of the powdered resin in cachets, commencing with doses of 5 gr. three times a day after meals, and gradually increasing the dose to one of 10 or 12 gr. In this form it can be taken without any discomfort to the patient, whereas if administered in the form of the tincture in a mixture a most nauseous medicine results. To prevent, as far as possible, the recurrence of gout the patient should also give careful attention to diet on the lines laid down under the heading of Diet. Regular habits of life, with even and sufficient exercise, should be encouraged, and constipation should be zealously avoided. Briefly stated, the individual who is subject to gout and who wishes to prevent a recurrence of the disease should lead an active and an abstemious life.

LOCAL TREATMENT OF GOUTY JOINTS.

If much swelling of a joint persists the limb should be elevated as much as possible and a light flannel bandage applied to the joint. If the œdema persists, the hot douche followed by sponging with a cold strong solution of common salt will be found serviceable. The application of the so-called solvents of uric acid externally to affected joints is useless, as they are not solvents of sodium biurate. Careful massage and gentle exercise of the stiffened joints should be employed, but only when convalescence is fairly established; massage and muscular movement increase the flow of lymph in the lymph channels and so tend to promote the removal of uratic deposits and to increase general metabolism.

A free movement of the lymph in the lymph channels is essential to oxidation and metabolism, and therefore massage and muscular movements exercise an important influence on account of the pumping action produced in the lymph spaces by both forms of exercise. Muscular movements and respiration are almost the only means by which the circulation is ordinarily carried on in this system, as it has no motor mechanism with the exception of the *vis-a-tergo* of the heart and arteries, and, if these latter are in default, delay and defective metabolism must result if muscular exercise is not taken. This is an argument, from the physiological side, in proof of the fact that a sedentary life and deficient exercise conduce to gout. Massage should never be resorted to in cases of acute gout, as it not only aggravates the disease at that stage, but causes severe pain; it should be reserved for the more chronic cases. Massage produces an increase in the amount of blood and lymph passing through the tissues concerned, at the time and afterwards. This improves the nutrition of the affected tissues, promotes absorption of deposits, and restores physiological activity. In subacute or chronic cases, where the joints remain swollen and œdematous, and are the seat of considerable deposits, much benefit is frequently derived from massage and galvanism. Each of the affected joints should be massaged for a few minutes, and then galvanism (5 to 10 milliampères) applied for a few minutes with the negative pole over the affected region, to be again followed by massage. Under this combined treatment the œdema and deposits frequently disappear rapidly. Probably the beneficial effects are due mainly to the increased circulation of blood and lymph induced, and the consequent absorption that takes place.

The Scotch douche is very useful in the treatment of chronically affected joints. A good-sized stream is thrown with considerable force upon the affected joint, cold water being first employed for half a minute, and then hot; the latter should be as hot as the patient can bear, and should be continued for one minute. This process is repeated for fifteen or twenty minutes. The repeated alternations of temperature produce a stimulating effect upon the circulation about the joint, and so increase tissue change and favour absorption. Massage of the joint should be resorted to immediately after the douching, as the tissues are then in a relaxed condition. In many cases of chronic articular gout the salt pack is efficacious. It consists of flannel soaked in a warm saturated solution of common salt, which is wrapped round the affected joint, covered with oiled silk and a bandage, and kept on all night. It should be repeated nightly as necessary.

For the stiffness and thickening of joints careful rubbing with iodide of potassium and soap liniment or with the compound camphor liniment may be resorted to. The thermal baths of Bath, Buxton, Harrogate, Strathpeffer, Llandrindod Wells, Aix-les-Bains, and other spas and mud-baths, are useful in the treatment of cases of chronic articular gout. Treatment by means of baths should, however, be avoided by patients suffering from acute gout, by elderly patients, and by those suffering from any serious cardiac affection.

Electric Light and Superheated Air Baths (*see* also special article).—I have found in many cases that a decidedly beneficial influence on gouty joints is produced by electric light baths, followed by electrical treatment in the form of cataphoresis to the affected joints.

Electric light and superheated air baths promote the oxidative processes within the body, as is shown by the increased elimination of carbon dioxide from the lungs, and also by the increased metabolism of the body in general. They also stimulate the circulation of both the blood and the lymph in the affected joints and so lead to improved nutrition of the parts. This curative action undoubtedly continues after the treatment has been left off. Such treatment, therefore, is better given intermittently—say, six baths on alternate days; then intermit for two or three weeks and so on. These baths improve the atrophic condition of the muscles. They cause a temporary elevation of the body temperature, marked reddening of the skin of the part treated, profuse local or even general perspiration, quickened pulse, lowered arterial tension, and generally considerable amelioration of the pain, and in some cases complete disappearance of it for a time. Radiant heat has a greater penetrative effect than other forms of heat, and, in my opinion, the effect is more stimulating. In cases of acute or subacute gout the pain, as a rule, recurs at varying intervals after a bath, but usually with diminished severity; and in favourable cases a progressive reduction of the pain occurs after the use of subsequent baths.

Undoubtedly many cases of chronic gout do not show much improvement after the use of electric light or superheated air baths, and I have frequently experienced great difficulty in selecting the cases most likely to be benefited by them. As a general rule, my experience has been that cases of chronic gout of long standing, with considerable deposits in the joints, do not derive much benefit from these baths. For such cases undoubtedly much more good can be done by the employment of vapour baths, followed by massage of the affected joints, a method of treatment which is frequently most useful in producing softening and absorption of the deposits. It should, however, be borne in mind that electric light baths seem to set up improved circulatory and trophic changes in the joints, which apparently are maintained for a prolonged period after the baths have been discontinued. Certainly I have seen in several cases, after a course of twelve to eighteen electric light baths had resulted in but slight improvement and the baths had been abandoned in despair, a progressive improvement maintained for weeks and even months after the discontinuance of the baths, an improvement which in some cases has resulted in more or less complete cure.

If only one limb is the seat of gout, the question arises as to whether that limb should be locally treated by being placed in a small specially constructed bath or whether the "entire body" bath should be used. My experience is that the "whole body" bath is in all cases the most useful, with, in the case of the electric light bath, an extra localisation of the heat and light rays on the affected part. That means, according to my experience, that the more extensive the surface to which the heat and light rays are applied the better is the result. When the ordinary electric light or superheated air baths are not obtainable, very good results may be obtained at home by the use of an ordinary blanket-tent with a small opening at the top to let out the hot air saturated with moisture. The hot air is supplied by a ring bunsen gas-burner, or by a large spirit lamp with a flue passing through an opening in the blanket at the foot of the tent.

In the acute or subacute stage of gout, or when a slight attack of gout has just started, I consider the use of the *Turkish bath* most undesirable. I have known of its employment in such cases being followed by an exacerbation of the attack and extension to joints not at the time affected. This is a point which should be borne in mind by medical men, as many patients on the first appearance of an attack of gout are apt to have immediate recourse to the Turkish bath, and it is well that they should be warned of the danger they thereby incur.

Cataphoresis (*see* also special article).—Cataphoresis is useful in many cases of chronic gout with considerable deposits in the joints. By cataphoresis is meant electric osmosis, or the transfer through porous partitions from anode to cathode. The joint may be treated either by immersion in a local bath of the fluid which is to be introduced, the positive electrode being placed in the bath and the negative on the back, or the positive electrode may be kept thoroughly wet by frequent applications of the fluid. The negative electrode should be a large one, about 8 inches by 5 inches, made of zinc and protected by a flannel cover. It is well moistened with warm water and applied to the lumbar or dorsal region. At the positive pole either potassium bicarbonate or lithium iodide may be introduced into the affected joint. In the former instance the positive electrode is kept thoroughly wet with a saturated solution of potassium bicarbonate; in the latter the joint is painted over with iodine liniment, and a pad of lint soaked in a saturated solution of lithium carbonate is laid over the iodine surface; on the lint the positive electrode, which should be a large flat one, is placed, and closely applied to it. Care must be taken to have everything *in situ* before turning on the current, so as to avoid any shock, and to give an easy, steady flow of current.

TREATMENT OF IRREGULAR GOUT.

Gouty Dyspepsia and Acidity.—In addition to the usual remedies, such as bismuth subcarbonate, sodium bicarbonate, bitters, etc., takadiastase is a most useful drug in the treatment of gouty dyspepsia. It is made up in the form of tablets containing 2½ gr. in each tablet, and one of these should be taken immediately before each meal. The takadiastase encourages the digestion of the carbohydrate elements of the food, and so prevents the development of fatty acids, which, by their irritating effects, are so common a factor in the development of gouty dyspepsia.

Hyperchlorhydria.—The treatment of this condition consists in a proper regulation of the diet by cutting off any excess of the proteid articles of diet and by neutralising the superfluous acid by the administration of some alkali. A drug that I have found most useful in the treatment of this hyperchlorhydria is hopogan (magnesium peroxide). It not only gives immediate relief of the pain and discomfort by its neutralising effect on the excess of acid, but it also parts with one-half of its oxygen and acts as an internal antiseptic. It is a most valuable drug in many abnormal gastric and intestinal fermentations. It is a white tasteless powder, and is best given in a little milk in doses of 20 to 30 gr. three or four times a day, taken one hour after meals. If it exerts too great a purgative effect the dose should be diminished. It is also very useful in allaying the irritation in many cases of gouty pruritis, which are probably due to absorption of a toxin or toxins from the intestinal tract. In cases of ordinary neurotic dyspepsia, associated with flatulence, the drug is, in my experience, of no value whatever.

Hepatic Torpor.—A very common form of irregular gout is due to defective metabolism of the liver, and is known as hepatic torpor, or hepatic inadequacy. In this form, the fæces are pale, generally very offensive, and, as a rule, constipation occurs. Slight jaundice is usually present, as evidenced by a yellowish conjunctiva and muddy complexion, and the urine is highly coloured, of high specific gravity, and very acid. In the treatment of this form of irregular gout the most important consideration is the restoration of the liver to its normal state of activity, and here the alkaline sodium salts are especially useful. There is no better treatment at the outset than a dose of "blue pill" or calomel at night, followed by a dose of Epsom salts or Carlsbad salts in the morning. Subsequently, a pill containing a small dose of "blue pill" or calomel, combined with euonymin and colocynth, will be found most useful. In such cases of gouty hepatic inadequacy a mixture which I have found most beneficial as regards its stimulating effect on the metabolism of the liver, and also of the gastro-intestinal tract, is the following, which should be taken a quarter of an hour before meals: Sodii Bicarb., gr. 12; Tinct. Nucis. Vom., ♏7; Tinct. Gentianæ Co., ʒss; Sp. Chloroformi, ♏12; Aq. Menth. Pip., ad. ℥j. [U.S.P. ℞. Sodii Bicarb., gr. 12; Tinct. Nucis. Vom., ♏16; Tinct. Gentian. Co., ʒss; Sp. Chloroformi, ♏9; Aq. Menth. Pip., ad ℥j.]

Gouty Heart is associated with fatty degeneration of the cardiac walls. The treatment should be rest in the recumbent position, and a small dose of "blue pill" or calomel, followed by a purge of Epsom salts, should be administered. If the pulse is of low tension a mixture containing convallaria and strychnine will be suitable. If anginal attacks occur, nitro-glycerine or erythrol tetra-nitrate may be given by the mouth, or inhalations of nitrite of amyl employed. Iodide of potassium is also a very useful drug when there is much pain. The patient must be carefully dieted, and graduated exercise, at first of a passive nature, such as the Schott treatment, and later of an active nature, may be very beneficial. The action of the bowels should be properly regulated, and entire abstention from tobacco smoking, or extreme moderation in its use, should be advised.

The anginal and syncopal attacks that occur in connection with the gouty heart do not prove fatal, but care must be taken not to overtax the heart, and at first only gentle outdoor exercise on the level should be allowed.

Angina Pectoris.—In anginal attacks in gouty subjects the pulse is generally one of high tension without the existence of any necessary association of atheroma of the vessels. For the immediate relief of the actual attacks nitro-glycerine is the best drug to employ, although in rare cases nitrite of amyl may be found more efficacious. Stimulants and morphine administered hypodermically should also be employed if necessary. For some days after an attack nitro-glycerine in doses of $\frac{1}{100}$ gr. should be given two or three times a day. If organic cardiac mischief exists, the condition must be suitably treated on general principles. In cases of anginal attacks occurring in gouty subjects, as soon as the severe pain has been relieved by the administration of nitro-glycerine, a pill containing 1 gr. of the acetic extract of colchicum and 3 gr. of "blue pill" should be given at night and should be followed by a dose of Epsom salts in the morning.

When the administration of nitro-glycerine is discontinued, citrate of potassium and iodide of potassium should be given for some time thrice a day.

Pseudo-angina Pectoris.—For the treatment of this affection a dose of hot brandy and water should be given at once and a mustard leaf should be applied to the epigastrium. On the subsidence of the severe symptoms a pill containing 1 gr. of the acetic extract of colchicum and 3 gr. of "blue pill" should be given at night, and should be followed by a dose of Epsom salts in the morning.

Gouty Phlebitis.—For the treatment of this fairly common form of irregular gout the patient should be kept in the recumbent position, and any sudden movement of the affected limb must be prevented on account of the danger of detaching a portion of thrombus and the occurrence of consequent embolism of the pulmonary artery. Equal parts of glycerine and extract of belladonna should be smeared over the affected part, and a linseed poultice with some of the glycerine and extract of belladonna spread on the surface should be applied and renewed every six hours. In addition to this the ordinary treatment of the gouty state must be resorted to.

Gouty Sciatica.—For the treatment of this painful affection the patient must be kept in the recumbent position, and in severe cases the pain should be relieved by a hypodermic injection of morphine. Ammonium chloride, given in doses of 30 to 40 gr. three or four times a day, is a very useful drug in the treatment of this form of irregular gout. Two grains of salicylate of quinine should be given in a pill two or three times a day. These measures should be supplemented by the ordinary treatment of the gouty state.

Gouty Neuritis.—Blistering along the course of the affected nerve trunk is the most rapid way of relieving this painful affection. If such a mode of treatment should not be considered desirable, then iodine liniment may be painted along the course of the nerve trunk and hot linseed poultices applied as soon as the iodine is dry, and kept in position by a bandage loosely applied. Internally, iodide of potassium combined with small doses of perchloride of mercury should be given.

Insomnia in Gouty Subjects.—Many gouty persons complain of insomnia or restlessness when in bed. This is frequently either toxic in its origin or is due to a state of high tension in the cerebral arteries. As a rule, the insomnia is not complete, but consists of restlessness, interspersed with varying intervals of light or broken slumber. In such cases careful attention should be given to the state of the pulse, the heart, and the condition of the urine. In many cases it will be found that the pulse is of high tension and is associated with accentuation of the aortic second sound, perhaps reduplication of the first sound in the vicinity of the apex of the heart, and a slight degree of albuminuria. In such cases the insomnia is best relieved by the administration at night of small doses of "blue pill" or calomel, combined with full doses of the extract of hyoscyamus. Bromide of ammonium may also be given as a sedative and as a drug which reduces arterial tension, but with such patients it is most undesirable to resort to the use of the ordinary hypnotic drugs.

Gouty Eczema.—Of the purely internal causes of eczema disorder of the gastro-intestinal tract should, in my opinion, be placed first. The gouty person is one who is not only liable to such disorder and to faulty assimilation of food, but is also particularly vulnerable to inflammations of the synovial and mucous membranes and of the skin.

In the treatment of this form of irregular gout special attention should be given to two details. One is to see that the bowels are freely opened, which at the outset may be secured by the administration of "blue pill" or calomel, followed by a saline. The other point is that entire abstention from alcohol is most desirable, at all events during the treatment and persistence of the eczema. It is best that any form of alcohol should be abstained from, but the prohibition applies more especially in my experience to the red wines. I have met with several cases occurring among gouty individuals past the middle age of life in whom two or three glasses of claret or burgundy will, in the course of a few hours, cause the development of an eczema. During the irritative stage of dry gouty eczema, I have found the application of a lotion consisting of liquor plumbi subacetatis (ʒj), liquor carbonis detergens (ʒj), aqua sambuci (ad Oj), most soothing, especially if followed by the use of a simple dusting powder, such as cimolite powder. For the acute moist type of eczema a similar lotion, but with a preparation of opium replacing the tar solution, is advisable.

When the eczema is in a chronic condition, much benefit is usually experienced from immersion in sulphur baths, such as those of Harrogate, Strathpeffer, Aix-les-Bains, etc. After the bath the skin should be carefully dried, and a dusting powder, such as cimolite powder, freely applied. In cases of gouty eczema and gouty pruritis a careful dietary must be enforced, care being taken to forbid all articles which the experience of the patient in the past has shown to produce dyspepsia. Persons who are subject to attacks of gouty eczema should avoid such acid fruits as strawberries, gooseberries, apples and pineapples; rhubarb also should be excluded from the dietary. As regards the medicinal treatment of gouty eczema my experience is that it is not necessary to give the ordinary anti-gout remedies, such as colchicum, etc. It is much more important to treat the dyspepsia and the catarrhal condition of the gastro-intestinal tract, which are generally present as associated or causative conditions, by the administration of subcarbonate of bismuth with the bicarbonate of sodium or the bicarbonate of potassium.

In cases of gouty pruritus or, as it is sometimes termed, latent gouty eczema, the severe itching is frequently relieved by the use of carbolic acid lotion, or the itching attending pruritus and urticaria may be relieved by the application of the following lotion: Liq. Plumbi Subacet., ʒij; Tinct. Opii, ʒiv; Aq. Rosæ ad ℥viij.

Rubbing the skin with a menthol cone moistened with water is frequently useful in relieving the irritation. For the treatment of dry skin eruptions Sir William Roberts recommended the skin to be rubbed with a piece of smooth hard paraffin night and morning, so as to leave on the skin a delicate coating, which then probably acts by protecting the cutaneous surface from the air.

Gouty Glycosuria and Gouty Diabetes.—*Dietetic Treatment.*—Careful dietetic treatment should be resorted to, without, however, restricting the diet too much. An excessively nitrogenous diet is to be avoided as tending to accentuate the gouty condition, but no hard and fast rules as to the amount of the diet can be laid down. Each case must be treated by ascertaining what amount of proteids, fats and carbohydrates is best borne by the individual. Toasted bread, milk and milk puddings made with rice, sago and tapioca, are generally permissible in this form of glycosuria. The best test of the suitability of the diet is the fact that the weight of the patient is not diminishing, while at the same time the excretion of sugar is becoming less. The patient should, therefore, be weighed once a week, and the whole of the urine for twenty-four hours should be collected once a week, measured, and the quantity of sugar determined in a sample of the mixed urines, so that the total output of sugar for the twenty-four hours may be known.

Medicinal Treatment.—A pill containing 1 gr. of "blue pill," 1 gr. of acetic extract of colchicum, and 2 gr. of euonymin [U.S.P. extract of euonymus] should be given every other night. A mixture containing 30 gr. of ammonium chloride and 15 min. of dilute nitro-hydrochloric acid in each dose should be taken three times a day; this mixture acts as a stimulant to hepatic metabolism. Opium and its alkaloids are best avoided. A list of the mineral waters best suited for the treatment of gouty glycosuria and gouty diabetes is given later on.

RETROCEDENT OR METASTATIC GOUT.

Immediate Treatment.—If the symptoms are urgent some brandy should immediately be given, and, if necessary, a hypodermic injection of morphine should be administered, provided marked albuminuria does not exist. If the metastatic seizure is a severe one, and especially if it affects either the heart or brain, it may be desirable to reinduce an attack of articular gout by placing the feet in a hot mustard and water bath, containing a full tablespoonful of flour of mustard to a gallon of water.

Treatment of the Gastro-intestinal Form.—A mustard leaf should be applied to the epigastrium, and a mixture containing bismuth subcarbonate, sodium bicarbonate and hydrocyanic acid should be given. If there is much depression suitable stimulants must be employed.

Treatment of the Cardiac Form.—Heart tonics, such as digitalis, convallaria or strophanthus, and brandy, should be administered. A mustard leaf may be applied to the epigastrium. If an anginal attack occurs, then, in addition to this treatment, a dose of nitro-glycerine should be given at once, or an inhalation of nitrite of amyl employed, and, if necessary, a mustard leaf should be placed over the præcordial region. For the treatment of syncopal attacks the patient should be immediately placed in the recumbent position, with the foot of the sofa or bed raised; some hot brandy and water should be given, warmth and friction applied to the extremities, and a mustard leaf placed over the epigastrium.

Treatment of the Cerebral Form.—If the patient is plethoric, and if the pulse is hard and stupor or coma supervenes, venesection should be performed, and from 8 to 16 oz. of blood withdrawn; in less urgent cases six leeches may be applied to the mastoid region. Five grains of calomel should afterwards be administered by the mouth and a turpentine enema given.

DIET IN GOUT.

General Principles.—No hard and fast lines as to dietary can be laid down in the treatment of gout. Each individual must be carefully considered as regards his habit of body, his capacity for the digestion of different articles of food, the amount of exercise he is able to take and the nature of his work. Derangements of the gastro-intestinal tract constitute a most important factor in the development of acute, chronic and irregular gout; for in all forms of gout, whether regular or irregular, there is one invariable symptom, viz., digestive disturbance. It is, therefore, of the utmost importance to secure and maintain a healthy condition of the gastro-intestinal mucous membrane, and a normal daily evacuation, in order to guard against auto-intoxication, which is undoubtedly an early factor in the development of the gouty condition. The individual who is subject to gouty attacks can certainly diminish the number and severity of the attacks, and in many cases can prevent their recurrence, by careful attention to diet, to the quality and the quantity of fluid taken, to exercise, and to a sufficient daily action of the bowels.

Gouty people may, for the purposes of the consideration of diet, be roughly grouped into three classes: (1) Those who suffer from more or less frequent attacks of acute gout; (2) those who have never suffered from an acute attack, but who are constantly subject to some chronic form of regular or irregular gout, especially after slight indiscretion in diet; and (3) those who are only affected with gouty symptoms (generally of the irregular kind) when they eat or drink certain articles, and who, therefore, in order to avoid these gouty symptoms, have to be specially watchful over their diet.

It is well known that the excessive consumption of rich nitrogenous food, combined with excesses in wine and malt liquors, both induces and excites gout. The comparative immunity of females and young people from gout is mainly explained by the absence of such determining causes of the gouty attack, combined in the case of young people, with the absence of predisposing cause and also with the fact that the secreting functions are in full activity. The subjects of gout are generally persons who live well and consume a large amount of animal food. Budd, speaking from a long and extensive professional connection with a large rural district, states that he never knew an instance of gout occurring in an agricultural labourer.

Digestibility of Food.—Gout, which is a toxæmia originating to a great extent in the alimentary tract, derives its toxic products from the improper digestion of foodstuffs. Whatever articles of food can be properly digested by the gouty are therefore suitable articles for their dietary. The physical condition of an article of food to a very great extent determines its digestibility. By digestibility is meant not necessarily the extent to which it is absorbed into the blood, but the power of disposing of the food by the stomach without the production of discomfort or pain. The digestibility of the various kinds of fish, and of the flesh of birds and animals, depends on the length of the muscular fibres, and on the amount of fat deposited between the fibres. The shorter the fibres, and the smaller the amount of fat deposited between them, the more digestible will the article of food be. If an article of food tends to be swallowed in a solid lump, such for instance as new bread or new potatoes, so as to prevent the ready permeation of the substance by the digestive juices, it tends to be indigestible purely by virtue of its physical condition. If such articles were first reduced to minute subdivision by thorough mastication and insalivation, their indigestibility, as far as ordinary individuals are concerned, would disappear.

It is not so much a matter of importance to know whether or not any particular article of food contains uric acid or its antecedents, as to know what are its properties as regards digestibility and as regards its influence on the processes which are concerned in the conversion of foodstuffs into bodystuffs. The researches of Pawlow have shown that the food value of any particular article of diet must depend to a large extent upon the amount of energy necessary for its digestion.

If gouty persons partake of meals of too complex a character, then, owing to the abnormal intestinal and hepatic metabolism of such subjects, excessive production and imperfect elimination of toxic products may result. Although both excessive production and imperfect elimination of these abnormal products of digestion go more or less together, yet it is a matter of fairly frequent observation that some gouty persons seem to be especially the victims of excessive production of toxic products, and others to be mainly affected by defective elimination.

In regulating diet it is very important to bear in mind that it is in many cases not advisable to change too suddenly the diet to which the patient is accustomed. The composition of the various digestive secretions is adapted to the food they have to digest, so that the individual who habitually eats an excess of proteid comes in time to have gastric and pancreatic secretions which will digest proteid well, and if the carbohydrates of the food have been limited, he will also have a limited capacity for their digestion; so that if a sudden change of diet is ordered it takes a little time for the constituents of the digestive secretions to adapt themselves to the altered food, and in the meantime the patient may feel worse for the change of diet which will ultimately benefit him. The diet suitable to any patient will depend on the digestive capability of that patient and should be regulated accordingly; it is important to remember to treat the individual as well as the disease.

Maintenance of a Healthy Alimentary Tract.—If, as is probably the case, the toxin or toxins of gout are produced in the intestinal tract, it is obvious that the first efforts at treatment should be directed to obtaining a healthy alimentary tract, and to modifying those habits of living which have caused gastro-intestinal derangement.

Before deciding how these objects can be attained it is first necessary shortly to consider some points in the digestive processes which take place in the small intestine. Under normal conditions bacterial decomposition does not take place in the upper part of the small intestine, as the duodenum and upper portion of the jejunum are practically sterile. The conditions which favour increased bacterial growth in the intestine are: (1) Increase in the amount of proteid food (the number of bacteria in the intestine varying directly with the amount of proteid food), and (2) the reaction of the intestinal contents. As long as the contents are acid, bacterial growth is inhibited, but when, owing to gastric or intestinal dyspepsia, the intestinal secretion is changed, the reaction of the intestinal contents changes, and great increase in the number of intestinal bacteria takes place, while at the same time their pathogenicity is increased. Therefore, the growth of bacteria in the intestinal tract and their pathogenicity will vary directly with the amount of proteid food and the amount of catarrh present.

These facts obviously have a great bearing on the treatment of gout and explain how it is that excess of proteid food, and those forms of alcohol which tend to produce intestinal catarrh, have such a strong influence on the production of gout.

As regards the amounts of proteid, fat and carbohydrate that the ordinary individual of average body weight needs during the twenty-four hours to satisfy the normal nutritive requirements of the body, it may be answered in a general way that he requires enough of these foodstuffs to establish physiological and nitrogenous equilibrium, sufficient, that is, to keep up the strength of body and mind that is essential to good health, to maintain the highest degree of physical and mental activity with the smallest amount of friction and the least expenditure of energy, and to preserve and heighten if possible the ordinary resistance of the body to disease germs. Chittenden's opinion is that the smallest amount of food that will accomplish these ends is the ideal diet. There must be enough to supply the true needs of the body, but any great surplus over and above what is really called for may in the long run prove an undesirable addition. It is therefore necessary to have definite and precise knowledge of the amount of proteid, and of the total calorific value, needed to maintain the body weight in the highest state of efficiency, before any very exact estimate of what constitutes over-nutrition or under-nutrition can be formed.

It must be understood that no diet contains an adequate amount of proteid food that does not keep up a condition of nitrogenous equilibrium. If the nitrogen output persistently exceeds the nitrogen intake, it is obvious that the body is feeding on its own tissue, which means that the proteid of the food is insufficient in amount. On the other hand, a diet that suffices to maintain body weight, with establishment of nitrogen equilibrium, should, so far as our present knowledge goes, be quite adequate to meet all the wants of the body for proteid matter.

Chittenden considers that the daily consumption of proteid food far beyond the amount required to maintain health, strength, mental and physical vigour, body weight, and nitrogen equilibrium, constitutes a form of over-nutrition as serious in its menace to the health and welfare of the human race as many other evils more striking in character. He believes that there are more people suffering to-day from over-eating and over-nutrition than from the effects of alcoholic drink. He maintains that if people, as shown by experiments, can maintain nitrogen equilibrium and body weight, gain in strength, show greater freedom from muscular fatigue, lose their rheumatic and gouty symptoms, regain a smooth and soft skin, exhibit greater freedom from colds, retain the normal hæmoglobin content of their blood, and in every recognisable way manifest a good condition of health on a low proteid diet, there should be no hesitation in accepting the teaching which the scientific data point to. Chittenden's experiments show that it is quite possible to maintain body weight, and keep up nitrogen equilibrium, and preserve strength, vigour and good health on from 34 grammes to 56 grammes of proteid matter per day. My own experience is that, on a diet containing this amount of proteid, gouty persons maintain their nitrogen equilibrium and body weight, become free from most of their gouty symptoms, and generally enjoy a good condition of health.

Animal Food.—As regards the question of meat, it must be remembered, on the one hand, that animal foods constitute to the majority of people the most attractive and appetising forms of diet, and are therefore likely to be taken in excess; hence the necessity for limiting the amount to be taken. But, on the other hand, it is most desirable to increase the combustion and the oxidative powers within the tissues. In my opinion it is absolutely erroneous to exclude from the dietary of the gouty such articles as meat, fish and tea, because they are assumed to contain uric acid.

The so-called estimations of uric acid in those articles of diet are not, as I have elsewhere pointed out, estimations of uric acid at all. Moreover, the deduction is an erroneous one, that because uric acid is a nitrogenous body, it must therefore be directly derived from nitrogenous constituents of the food, the consumption of which must consequently be avoided.

On the whole, it may be stated that animal food, such as fish, chicken, game and meat, is best suited to the majority of gouty cases, whilst foods of the farinaceous class are most likely to disagree. White meats, such as chicken and fish, are more digestible than red meats. The quantity of meat, and especially of red meat, must be restricted in those cases in which the kidneys are imperfectly performing their eliminating functions, as evidenced by a pale urine, of low specific gravity, and deficient in urea and purin bases.

Purin-free Diet.—A purin-free diet is one selected from milk, cheese, butter, white bread, cereal foods, nuts and fruit. Milk suits gouty people very well, and milk has a special effect in reducing the number of intestinal bacteria, their number being less with a milk diet than with any other.

It is true that a purin-free diet has proved of benefit in certain cases of disease, but there is every reason to believe that in such cases an equal benefit would be obtained by a mixed diet, in which the proteid consumption is kept down to a minimum. So long as temperance in the ingestion of proteid is observed, it matters but little from what source the proteid is derived.

From Walker Hall's experiments it would appear reasonable to administer sweetbread to gouty patients, since its nuclein portion is only slightly absorbed, for thymus sweetbread contains principally adenin, which is rapidly excreted, and pancreas sweetbread contains mainly guanin, an amino-purin incapable of increasing the urinary purin output and of exerting any injurious effects upon the tissues.

Vegetable Food.—A fair proportion of vegetable food should be taken with two meals each day. The choice of vegetables will depend upon the digestive capacity of the patient; but, excepting the potato, as a rule those vegetables that grow above ground are preferable to root vegetables. Whereas the mineral constituents of meat exercise a marked effect in diminishing the solubility of a gouty deposit, the mineral constituents of most vegetables exercise a marked power in increasing its solubility. The vegetables, the mineral constituents of which are most efficacious in this respect, are spinach, Brussels sprouts, potatoes, cabbage and French beans. At the same time with certain patients some of these vegetables may tend to produce some form of dyspepsia. I must again insist that in the dieting of the gouty no hard and fast rules can be laid down, but the idiosyncrasy of each patient to various articles of diet must be made the subject of careful observation and study. Due consideration should also be given to the patient's experience of what articles of diet disagree or agree with him.

Starchy and Saccharine Foods.—A diet that too largely consists of bread and starchy material leads to gravel in a number of cases. The frequency of uric acid gravel and stone among the rice-fed Hindus is well known. Starchy articles of food should be especially limited in amount in those gouty individuals who are subject to gastric hyperacidity (hyperchlorhydria). This condition is not due to gastric fermentation, but to an excessive secretion of hydrochloric acid by the gastric glands, and is a common cause of dyspepsia, and ultimately of gastric dilatation. It is due to an acid dyscrasia, as the result of which the secretion of gastric juice does not cease with the digestion of the proteid materials of the food, but continues after they have been disposed of. The result is that a considerable portion of the starchy materials is kept back in the stomach, and this retained starch keeps up the gastric secretion, without at the same time giving it any work to do.

When intestinal fermentation and putrefaction occur, as evidenced by a sense of discomfort after a meal, I attach great importance to the reduction of the starchy articles of food, but not to the total exclusion of what I believe to be comparatively harmless, the potato. Certainly those who are gouty and fat should be very sparing in the use of potatoes, as of other carbohydrate forms of food. I wish, however, to protest against the too general exclusion from the food of the gouty of so popular and useful an article of diet as the potato. The best form in which potatoes can be taken by the gouty is the crisp form, which requires thorough mastication and insalivation. Boiled new potatoes should be absolutely interdicted.

Equally wrong, in my opinion, is the total exclusion of sugar from the dietary of all gouty individuals. Undoubtedly in certain individuals sugar may do harm, as in the cases of gouty persons who are fat, or who suffer from glycosuria, or who are prone to attacks of eczema; and in such it should be cut off. That, however, is no reason for the exclusion of it from the dietary of all gouty patients. Many gouty individuals take sugar with absolute impunity. Some undoubtedly digest very badly all starchy articles of diet, and in such fats may well take the place of starches. Fat bacon, properly cooked, is generally well digested.

Subjects who are both gouty and fat should avoid sugar, but undoubtedly sugar may be taken with advantage by those who are gouty and thin, and such subjects may also take in moderation marmalade and wholesome jams. Bread may advantageously be given as crisp toast, or in the form of rusks, or in the "Zweiback" or twice-baked form, as in these conditions it requires thorough mastication and insalivation.

In those cases in which it is desirable to reduce the carbohydrate intake such restriction may be achieved (1) by cutting off sugar, and all articles containing any form of sugar; (2) by carefully graduating (by weight) the daily intake of starch-containing foods, so as to attain the minimum consistent with adequate nutrition in each individual case; (3) by similarly graduating the intake of fats if necessary; and (4) by throwing the onus of nutrition to a considerably greater extent than previously upon fish, lean meat, green non-starchy vegetables and gelatinous soups.

Fruits.—Any fruit which from experience is known to agree with the individual may be taken by gouty subjects. Apples and oranges generally agree best. Uncooked fruit should never be taken at a meat meal, and is best consumed fasting fairly early in the day, as between breakfast and lunch. It should always be thoroughly masticated. Strawberries are frequently avoided by the gouty owing to their producing in some subjects a certain amount of temporary irritation of the skin, but such irritation generally passes off in a short time. In a few subjects strawberries produce eczema or some other rash, but such cases merely represent idiosyncrasy to the special fruit, and necessarily such individuals, whether gouty or not, should not eat strawberries. I am, however, strongly of opinion that the indiscriminate banishment of strawberries from the dietary of the gouty is unnecessary. Except in those cases in which there is an idiosyncrasy to their use they constitute a good article of diet, on account of their delicious flavour, their antiscorbutic properties, and their richness in potassium salts. It is, however, very necessary that they should be ripe and fresh. They are soon prone to decomposition, and in such a state they aid in the development of those intestinal fermentations which are so inimical.

Articles of Diet to be Avoided.—Rich meat soups, ox-tail, turtle, mock turtle, kidney, mulligatawny, hare, giblet.

Salmon, mackerel, eels, lobster, crab, mussel, salted fish, smoked fish, preserved fish, tinned fish.

Duck, goose, pigeon, high game.

Meats cooked a second time. Hare, venison, pork, lean ham, liver, kidney; salted, corned or cured meats, pickled meats, preserved and potted meats; sausages; all articles of food pickled in vinegar; all highly seasoned dishes and rich sauces.

Tomatoes, beetroot, cucumber, rhubarb, mushrooms, truffles.

Rich pastry, rich sweets, new bread, cakes, nuts, dried fruits, ices, ice-cream.

Diet in Chronic Gout and for Gouty Subjects. — The following plan gives an indication of the diet to be recommended:

Morning.—Half a pint to a pint of hot water, flavoured with a slice of lemon-peel, should be slowly sipped immediately on rising.

Breakfast.—A selection may be made from the following articles of diet, according to the taste of the patient: Porridge and milk, whiting, sole or plaice, fat bacon, eggs cooked in various ways, dry toast or "Zweiback bread," thinly buttered, and tea infused for three minutes and then strained from the leaves. Fat bacon is digestible when grilled, but less so when boiled. Eggs should not be taken hard-boiled.

Lunch and Dinner.—Soups suitable for the gouty are vegetable *purées*, and soups made by boiling beef or mutton bones with vegetables, and subsequently removing the fat which separates on cooling. These soups should not be thickened with farinaceous substances.

The varieties of fish most suitable to the gouty are whiting, sole, turbot, plaice, smelt, flounder, grey mullet and fresh haddock.

The birds that are admissible as articles of diet are chicken, pheasant: turkey and game (not high).

Butcher's meat: mutton, lamb or beef should be taken at only one meal in the day, and then in moderate quantity.

Two vegetables may be taken at both lunch and dinner. Any of the ordinary vegetables may be taken, except those previously mentioned as best avoided; but those that I consider most likely to prove beneficial to gouty subjects are spinach, Brussels sprouts, French beans, winter cabbage, Savoy cabbage, turnip-tops, turnips, and celery. Potatoes may also be taken in moderate quantities. Stewed fruits, or baked apples or pears, may be taken every day at one meal.

Green vegetables as salads may be taken, provided oily dressings are avoided. A simple savoury may, if desired, be taken at the end of dinner, or a small quantity of cheese, if well masticated, and if free from the penicillium fungus or mould.

At Night.—Half a pint to a pint of hot water, flavoured with a slice of lemon-peel, should be slowly sipped before retiring to bed.

With regard to persons who are disposed to gout, but are not actually suffering from it, the usual mixed diet may be taken, but they should limit the starchy articles of food, and should avoid all rich sweets, rice, tapioca and sago. Thin and ill-nourished subjects require modifications in their diet as compared with people who are stout, while those who take plenty of exercise can take food forbidden to the sedentary.

Individuals who especially benefit by a reduction of diet, both as regards quantity and quality, are those overfed people who are past middle life.

ALCOHOL IN GOUT.

Stated as a general principle, a person who is subject to gout is better without alcohol in any form. There are, however, some who require a little alcohol, either to aid digestion or to enable them to get through their work, and here I am entirely in accord with the advice given by Sir James Goodhart, that if a man requires any stimulant at all, it is a matter he must decide by experiment for himself, for no medical man can tell him. If alcohol is necessary or desirable, the form in which it is to be taken is frequently a matter which the patient can decide better than the medical man, but I would insist upon the importance of definitely limiting the amount to be taken, and of restricting its consumption absolutely to meals. Some patients find that a little whisky or brandy suits them best; others find a light still Moselle preferable; a few, but in my opinion only a very limited number, find that a light claret agrees best with them. Champagne is a wine which is seldom suited to the gouty, especially if taken daily. In elderly people or in the feeble, a moderate amount of pure whisky undoubtedly does good, but the indiscriminate ordering of whisky to gouty subjects is, I am sure, wrong.

It is well known that certain alcoholic drinks injuriously affect the gouty process, whilst others exert a less injurious influence. Alcoholic drinks which have been obtained by fermentation, but which have not been submitted to distillation, such as wines and beers, appear to exercise a more harmful influence than if the same amount of alcohol be consumed in the form of one of the distilled spirits, such as whisky, brandy, etc.

Port is a wine which is especially unsuited to the majority of cases. The gout-inducing properties of the wine are, I believe, mainly dependent upon the ethereal compounds which give the aroma or bouquet to the wine, although these bodies do not act directly on either the quadriurate or biurate of sodium. If this view is correct it would explain the well-known fact that old and matured ports are much more provocative of gout than comparatively new ports taken direct from the wood. The development of the ethereal compounds in the wine extends over many years, and especially progresses after the wine is laid by in bottles. In a few cases of asthenic gout, especially in old people, a moderate amount of comparatively new port taken direct from the wood undoubtedly does good.

In my opinion the wines which are least injurious as a rule to those patients to whom it is found necessary to order a small amount of wine are the light still white wines, such as Moselle, certain French wines, certain Austrian wines, hock, and a few of the lighter Australian and Californian wines. These last, owing to their greater alcoholic strength, should be taken diluted with water or some mineral water.

Gouty subjects suffering from glycosuria or diabetes should entirely abstain from alcoholic drinks, unless marked debility and loss of appetite necessitates the restricted administration of them. Those who are subject to attacks of eczema are also much better without alcohol in any form.

"Rough" cider, that is, the completely fermented apple-juice, taken in moderation, agrees well with most. It contains but a small percentage of alcohol, is free from sugar, and its acidity is chiefly due to malic acid, which passes into the circulation in the form of alkaline malates, which, in their turn, are converted in the kidneys into alkaline carbonates and excreted as such, thereby increasing the elimination of urates. The bottled or "champagne" cider, which is imperfectly fermented, should never be used for this disease, owing to its undoubted liability to set up gastro-intestinal fermentations. Dry or "rough" cider, mixed with an equal quantity of an aërated water is an excellent beverage. Dry perry is also a suitable drink.

PREVENTIVE TREATMENT.

Mineral Waters.—The value of a given mineral water in the treatment of gout depends greatly on the object with which it is taken. For instance, it may be given to remove deposits, to stimulate the action of a sluggish liver and to relieve portal congestion, for the treatment of dyspepsia, to relieve the bowels in cases of torpor and gastro-intestinal catarrh, to act on the kidneys, or to relieve gouty affections of the skin. It is manifest that any one mineral water is not likely to produce all these effects, and it is also conceivable that a water which might effect one of these purposes might prove injurious if employed to fulfil another. No doubt considerable error has arisen from indiscriminately sending patients to a particular spa, without duly considering whether the water of that spa is suited to the specific disorder from which the patient is suffering.

There is a tendency with some medical men to consider that the efficacy of a natural mineral water is due solely to its watery constituent; in other words, that its one therapeutic use is that of a flushing agent. On the other hand, an exaggerated importance is not infrequently attached to the particular salts contained in a mineral water as ascertained by chemical analysis. The fact is, that in judging of natural mineral waters we have been too much under the domination of analytical chemistry, and our deductions from these results have been consequently biased and cramped. The more I consider their therapeutic effects, the more convinced I am that chemical analysis, although it can inform us what their mineral constituents are, is yet unable to determine exactly the state of the salts dissolved in them. The "ionic or electrical dissociation theory," and the existence of the mineral constituents of natural waters as "ions," are leading our thoughts to a new and, I believe, more correct appreciation of the therapeutic values of these waters. In intimate relation with this aspect of the matter is the question of radio-activity as possessed by these waters. Most, if not all, which have been subjected to examination, have been found to be distinctly radio-active, and the lower the mineralisation of the water the more intense is its radio-activity. In this, I think, lies the explanation of the fact that an artificially prepared mineral water, although identical in chemical composition with the natural one, does not possess the same therapeutic effects, since it is lacking in the property of radio-activity. A natural water at the moment of its discharge from the earth is radio-active, whereas an ordinary drinking water does not possess this property to any appreciable extent. Hence also the desirability of drinking the water at its source, since by the bottling and keeping of a natural water, the radio-activity is to a great extent lost.

Useful as may be the drinking of a water at a spa, yet equally, or even more so, is the encouragement of the functions of the skin by balneological methods for therapeutic purposes. The skin is the largest organ of the body, and it possesses various and complex functions. Amongst these are: (1) The excretion of toxic bodies, the retention of which prove harmful, and ultimately fatal, to the organism; (2) the power it possesses through its nerve endings of stimulating distant organs and tissues, and (3) its heat-regulating power. The success of balneology, whether in the treatment of chronic joint conditions, of affections of the fibrous tissue, of certain heart and kidney affections, or of certain skin diseases, depends upon the recognition of the powerful aid which can be given by the skin in restoring the normal balance.

If the view as to the intestinal origin of the toxæmia present in gout is correct, the value of mineral waters, both as curative and preventive agents, becomes at once intelligible from the marked influence they have on the metabolism of the intestinal tract, and their power of removing by the bowels the antecedents of the toxin causing gout.

It is especially in cases of chronic gout, of gastro-intestinal catarrh and torpor, of gouty dyspepsia, sluggish action of the liver, gouty eczema, gouty glycosuria, and of other forms of irregular gout, that mineral waters prove so valuable; whilst the various baths, combined with massage, are so useful in producing softening and absorption of the deposits in the joints and other tissues. Patients actually suffering from acute or subacute articular gout, or who are apparently on the verge of such an attack, are better without sulphur waters, as in such cases the waters tend to accentuate or precipitate an attack in the joints.

Choice of a Spa (*see* article on Hydrology).—In the selection of a spa so many factors have to be considered, that it is impossible, in a work of this nature, to deal fully with the subject. I wish, however, to state clearly that the high state of efficiency to which our home spas have been raised, render it no longer essential to banish our patients to foreign health resorts, and that, unless a complete change of environment is desired by our patients or is essential to their recovery, treatment can, in the great majority of cases, be carried out as effectually in our own country.

The following table (p. 460) may be of some value, as being an attempt to classify the therapeutic indications of mineral waters in the treatment of gouty conditions.

CLASSIFICATION OF THE VARIOUS MINERAL WATERS ACCORDING TO THEIR THERAPEUTIC VALUE IN THE TREATMENT OF THE VARIOUS FORMS OF GOUT.

Object of taking the Water.	The Waters best suited to the purpose.
Absorption of gouty deposits from the joints and tissues.	Bath, Buxton, Contrexéville, Gastein, Harrogate, Pfaëffers, Strathpeffer, Teplitz, Vittel, Wildbad, Aix-les-Bains (for baths).
Treatment of gouty dyspepsia .	Brides-les-Bains, Carlsbad, Ems, Harrogate, Homburg, Kissingen, Neuenahr, Royat, Vals, Vichy, Wiesbaden.
Treatment of gouty congestion and torpor of the liver, and of gastro-intestinal catarrh and torpor.	Baden-Baden, Bourbonne, Carlsbad, Cheltenham, Contrexéville, Harrogate, Homburg, Kissingen, Leamington, Llandrindod, Marienbad, Neuenahr, Tarasp-Schuls, Vals, Vichy, Vittel, Wiesbaden.
Treatment of gouty affections of the respiratory organs.	Ems, Royat.
Treatment of gouty glycosuria and diabetes.	Carlsbad, Contrexéville, Harrogate, Kissingen, Leamington, Llandrindod, Marienbad, Neuenahr, Strathpeffer, Vals, Vichy, Vittel.
Treatment of gouty skin affections.	Aix-les-Bains, Baden, Bagnères-de-Luchon, Harrogate, Llandrindod, Schinznach, Strathpeffer.

Climatic Treatment (*see* article on Climatology).—A fairly bracing air with a low relative humidity is, in my experience, the most suitable for the gouty. High mountain situations and valleys where there is an excessive relative humidity of the air are alike unsuited. Especially is it desirable to avoid exposure to the cold east and north-east winds which prevail in this country in the early months of spring, and which are so apt to be provocative of what has been called a "chill on the liver," a condition which no doubt is brought about by the chilling effects of these winds on the skin, and a consequent reflex affection of the metabolism of the liver cells.

A typically bracing climate is provided by a place which is exposed and elevated, which has a low relative humidity and is therefore liable to rapid variations of temperature. A typically relaxing or sedative climate is one in which the opposite conditions prevail. It is sheltered and low-lying with a high degree of relative humidity, and is therefore remarkably equable, both seasonally and diurnally. The physiological effect of a bracing climate is to increase metabolism, of a relaxing climate to diminish metabolism.

There are some types of gout which benefit conspicuously from bracing climates, but these are the less pronounced types in which stimulating conditions may be tried without danger. On the other hand, those types of gout which are associated with chronic renal disease, and older patients suffering from arteriosclerosis and high arterial tension, are best treated by sedative climates. In cases of chronic renal disease, care must be taken to avoid any sudden or extreme change of temperature which would impose an undue strain on the damaged kidneys. It is in such cases that relaxing climates are frequently of immense benefit. In cases of gout associated with fatty degeneration of the heart or with valvular disease, a sedative climate is most desirable.

All gouty individuals should avoid localities in which there are hard chalky waters or, if they have to reside in such localities, should avoid drinking the water of the district. In such cases they should drink distilled water, plain or aërated, or some of the simple natural mineral waters. As a winter resort for the gouty I know of no better climate than that of Egypt, where, at Helwan (Helouan), thermal, sulphurous and saline waters exist, and excellent baths are obtainable. The air of Helwan is that of the desert, and almost germ free. The winter sunshine averages eight hours a day; the average winter temperature is 60° F. at 9 a.m. and 9 p.m., 70° F. at 3 p.m., and 50° F. at the coldest time of the night, and the relative humidity from November to April only 30 to 60 per cent. There is not much wind, and the amount of dust is less than in most parts of Egypt, while the average rainfall for four consecutive winters was only ¾ inch. For the spring, summer, and autumn months we fortunately have for our selection a large number of health resorts in this country and on the Continent, the climates of which are well suited to the gouty. My experience is that residence by the sea is not suited to most cases of gout, and this especially applies to cases of gouty eczema.

ARTHUR P. LUFF.

LARDACEOUS DISEASE (ALBUMINOID OR AMYLOID DEGENERATION).

This disease is found as an accompaniment of prolonged suppuration, where the source of pus is a large and imperfectly drained cavity. The discharging tuberculous abscess, arising from bone, joint or spine which has undergone secondary infection with pyogenic organisms, is the usual cause. Prolonged discharge of pus from a large empyema cavity also gives rise to the condition. In all cases of suppuration the onset of amyloid degeneration is to be watched for. The appearance of albuminuria, enlargement of the liver and spleen, and progressive anæmia are of serious import. It is true that lardaceous disease is not rapidly progressive, but it is inevitably fatal unless the suppurative process can be controlled. Heroic measures may be necessary to effect this, and to be successful they must not be delayed until the last stages of the disease. The surgeon must first assure himself that there is no retained collection of pus. Drainage must be as free as possible, and by irrigation with mild antiseptics and careful dressings endeavours are made to diminish the amount of discharge.

Open-air treatment, and the dietetic and hygienic *régime* usually associated with it, should be insisted on. Rest is necessary in most cases, but rest and open air treatment are not incompatible. Should these measures fail to check the course of the disease, the possibility of removal of the diseased part by amputation must be considered without delay. Amputation at the hip-joint, in cases of far-advanced tuberculous disease of that joint with multiple and profusely discharging sinuses and well-marked lardaceous disease, sometimes gives striking results. Not only does the patient regain the appearance of health, but all external evidence of the presence of amyloid, disease disappears. When not unjustifiably delayed, the immediate mortality associated with such an operation is small.

MAYNARD SMITH.

MARASMUS.

The term marasmus denotes severe wasting in infancy not due to definite disease. It should be separated, when possible, from general tuberculosis, syphilis, and disorders of the stomach and intestines, which are frequent causes of wasting. It is most important to recognise syphilis, because the specific treatment for that infection must be applied. General tuberculosis is not known in early life to yield to treatment. The diagnosis from the wasting of gastro-intestinal disease is less essential because the treatment is similar: it will depend upon whether the evidence of such disease preceded the wasting, or whether wasting took place first. Marasmus predisposes to gastro-intestinal irregularities, such as vomiting, diarrhœa or constipation, which are then secondary symptoms. It is really the result of slow starvation of a baby. It may be due to the child having been born so weak that it cannot take enough food, but this is seldom the case; more commonly the child is starved because it has not been supplied with enough food of the right kind. Lack of fresh air and cleanliness, and of the exercise which a baby receives from nursing and dandling, are contributory causes.

Prophylaxis.—The chief preventive measure is breast feeding. Out of fifty-one severe cases of marasmus admitted to the wards of the Victoria Hospital for Children, under the care of Dr. Carr, Dr. Rolleston and the writer, only six had been fed at the breast entirely for more than two or three weeks after the puerperium. Most of them had received insufficient quantities of diluted cow's milk or of some condensed milk or patent food, Nestlé's milk being most frequently quoted as the baby's food. Sufficient air-space must be provided for the child, at least 1,000 feet for each cot; it should also be taken out of its cot regularly and nursed and played with. These two points are of special importance in hospitals, infirmaries and children's homes, for babies may fail to thrive in such institutions in spite of receiving enough good food.

General Treatment.—Marasmus in young infants requires to be treated without delay, for the mortality is high. Out of thirty-nine severe cases of the age of four months or under in the above-mentioned series, no less than twenty-one died. If we exclude seven which died within twenty-four hours of admission, and may be regarded as moribund when brought to the hospital, there were still fourteen deaths out of thirty-two cases; of the older children three out of twelve died, or, if those dying on the first day are excluded, one out of nine.

In severe cases the first step is to put the baby into an *incubator;* by this means the heat lost from the body is diminished, and a smaller amount of food is sufficient for its needs. At the Victoria Hospital a simple incubator, the application of which to cases of collapse in babies was suggested by one of the Sisters, is made as follows: The body of the child is covered with a blanket, over which a surgical bed-cradle is placed. The cradle in turn is covered with blankets, and in the cradle an ordinary electric lamp, surrounded by a wire cage, and a thermometer are hung. The stem of the thermometer projects above the cradle and can be read by the nurse. By altering the thickness of the blankets or allowing more or less ventilation it is easy to keep the temperature of the space inside the cradle within a few degrees of 100° F. No flannelette must be used near the lamp. The baby's head lies outside the head of the cradle in the usual way. This simple arrangement has been found of great value not only in marasmus, but in other conditions of malnutrition and in collapse from any cause, including collapse after operations. If no such device is available, the baby may be rubbed with oil, rolled in cotton-wool and surrounded with hot-water bags.

Dietetic Treatment.—Every effort must be made to supply nutriment in a form which the baby can take and assimilate. The best plan, though seldom practicable, is to get a wet nurse. Failing this, we have, first, to find a food which the child can retain; secondly, to increase the daily amount of that food; and, thirdly, to pass the infant by easy stages to the diet suitable to its age. These infants often take food extremely slowly; they are also liable to vomiting, which occurred at some time in twenty-eight out of fifty cases, and, less frequently, to attacks of diarrhœa (twelve out of fifty-one cases). If the mother's account shows that the baby has been having a reasonable diet, such as milk and water, but not enough of it, and if that food is not vomited, it is well to continue it, increasing the amount and strength of each feed gradually. In many instances, however, the history is that numerous foods have been tried, but that the child will not thrive on any of them. The most generally useful food is peptonised milk. It should be peptonised for an hour, and given in feeds of 2 oz. every two hours at first, except in weaker infants, who may require to be fed hourly or even half-hourly for a time. If the milk is rejected, less should be given until that quantity is found which is retained. The baby may object at first to the bitter taste of milk peptonised for so long, but does not notice it after a feed or two.

In still severer cases it is necessary to begin with albumin-water, passing to whey; then the whey may be mixed with peptonised milk in increasing quantities till peptonised milk alone is given, and to this cream or cod-liver oil may be added; later the time of peptonising is gradually reduced until the infant can be led to take feeds of milk, water, lactose and cream. Care, patience and ingenuity are required in prescribing the diet. If an infant is not getting on it is often advisable to go back and begin again with lighter feeds; this should be done without hesitation. For instance, a baby of four and a half months was fed at first on albumin-water, passing to dilute peptonised milk, and then to milk, water and lactose; but although the food was retained there was no increase of weight. It was then given whey alone, to which in a short time peptonised milk was added, with the result that weight was now put on; later citrated milk, water and lactose were taken well, and finally cream was added. In another case, aged two months and weighing 6 lb., milk and water and peptonised milk were rejected successively; whey was then retained, but on putting some cream to it vomiting recurred; the cream was then omitted, and peptonised milk gradually added to the whey with success; when the infant left the hospital it was taking milk, water and lactose. In another case, aged one month, citrated milk, water and lactose were tried in vain, then meat juice was given, from which the infant passed to whey, then to feeds of peptonised milk and lactose, alternating with feeds of whey, then to peptonised milk alone, the time of peptonisation being gradually reduced, and finally to milk, water and lactose.

The strength of the milk or peptonised milk used will vary with the age and severity of the case. Weak solutions should be tried first with low fat and protein (*see* article on Infant Feeding): egg-albumin (ʒj) or albulactin (gr. 7) may be added. Very weak solutions cannot, however, supply enough nourishment, and should soon be made stronger. Not infrequently the ordinary peptonised milk in small doses will be more successful than a diluted milk in larger doses. For instance, a child of six months, weighing 9 lb., lost weight on equal parts of milk and water with lactose, on feeds containing three parts of milk to two of water, and on feeds of peptonised milk and water in the same proportion; peptonised milk alone was then given with excellent results, and later changed to milk, water and lactose.

Other foods are whey and cream (*see* article on Infant Feeding), veal-tea and cream (veal-tea is made like beef-tea), which I have found useful, and meat juice and cream, *i.e.*, meat juice, ʒj, centrifugal cream, ʒjss, lactose, ʒj, water to 4 oz. Or meat juice, ʒj, brandy, ʒj, water to 6 oz.; 1 oz. every hour for a child of three months, 18 feeds being given in the twenty-four hours. Another prescription from the same author (Sutherland) is: Eggwhite, ʒij, brandy, ʒj, malt extract, ʒj, water to 6 oz. Brandy is only to be used if collapse is present or is feared. Marasmic babies are apt to become suddenly collapsed and die if the temperature is subnormal, especially in the night or early morning. Myers and Still recommend white-wine whey made as follows: 10 oz. of milk are raised to the boil and 2½ oz. of sherry added; the whole is brought to the boil again, removed from the fire, and allowed to stand for three minutes. The curd is then strained off. The whey contains about 5 per cent. of protein, 1 per cent. of fat, and 5 per cent. of sugar, with alcohol equivalent to 25 drops of brandy in each 1 oz. This may be used for a week or ten days, a child of six weeks beginning with ½ oz. every half or three-quarters of an hour, increased until 2 oz. are taken every two hours. It may be given instead of plain whey, to lead up to peptonised milk. Other foods which have been found useful in special cases as temporary expedients in the transition to the diet of health are dried milk (glaxo), Allenbury No. 1, Horlick's malted milk, virol, and Nestlé's milk.

Perseverance is essential in the treatment. It frequently happens that the weight falls at first, to rise later. In eight out of twenty-seven cases that recovered the weight went down steadily at first. Further, after the weight has begun to rise it may fall again, as happened in six of the cases. Sometimes infants come to a standstill in hospital: if the child did well at first but has ceased to make progress, it is often a good thing to send it home, where it will be nursed outside its cot and get more exercise. Holt recommends that marasmic infants should be made to cry lustily at least once a day to expand the lungs. Gentle slapping or putting the baby into hot or cold water alternately will attain this end.

Medicinal Treatment.—Drugs should not be ordered, as a rule. If there are green stools or any intestinal disorders, a dose of castor-oil should be given at the beginning of treatment, unless collapse is imminent: ⅓ drachm is enough for a child of three months, ½ drachm at six months. Or a mixture containing 10 drops in 1 drachm may be ordered night or morning for a day or two, or, for infants over six months, three times a day in drachm doses:

Castor oil, 10 drops ; spirit of chloroform, 2 drops ; potassium carbonate, ½ gr. ; mucilage of acacia, 15 drops ; syrup, 15 drops ; dill water, to ʒj. Or grey powder, ¼ to 1 gr., sodium bicarbonate, 2 gr., may be ordered three times a day, or every four hours for eight doses.

If *collapse* threatens, 20 drops of brandy, well diluted, a hot mustard bath (1 tablespoonful of mustard to 1 gallon of water : the child should not be kept in more than three minutes), or warm saline infusion under the skin should be ordered. A subcutaneous injection of strychnine may be given in extreme cases of $\frac{1}{200}$ to $\frac{1}{100}$ gr. Robert-Simon, of Paris, reports enthusiastically of the benefit of *subcutaneous injections of purified seawater.* The water is collected over twenty miles from the shore in sterile vessels, but must not be heated itself, and must be used within three weeks of its collection. Ten to 30 cubic centimètres are given to babies of 6 lb., and 25 to 50 or even 100 cubic centimètres to babies of 9 to 20 lb., an injection being made every three days, or in severe cases every day. He relates that babies at the " last gasp " are able after an injection to take and digest a meal of milk suitable in quantity for a normal child of the same age and weight, the mortality in such advanced cases being reduced to 2 or 3 per cent. I have used this treatment in a few cases with variable results.

E. I. SPRIGGS.

OBESITY.

THE successful treatment of obesity depends upon the recognition of its cause. (1) **Ordinary Obesity,** or the " middle-aged spread," may, in a general way, be regarded as due either to an excess of intake or an insufficiency of output; either the whole amount of food ingested is greater than the physiological requirements of the individual, or the output in the form of muscular work or nervous energy is inadequate. Not infrequently, especially in the case of town-dwellers, both these factors are at work. (2) **Anæmic Obesity,** in which the metabolism of fats is compromised by an insufficiency of hæmoglobin, and hence of oxygen. This is seen in chlorosis and in the obesity which follows menorrhagia or other profuse hæmorrhages. (3) **Toxic Obesity** : (*a*) Substances which interfere with metabolism, such as alcohol, arsenic and mercury, when taken injudiciously, readily give rise to obesity; (*b*) poisons, such as that of typhoid fever, which exhaust the metabolic activities, produce the same effect. (4) **Internal Secretory Obesity**: This is a large class including some forms which are essentially transitory and others whose tendency, in the absence of appropriate treatment, is to persist. Of the former it is only necessary to instance such causes as puberty, marriage and maternity. Of the latter there are the obesity of the menopause, adiposis dolorosa (Dercum's disease), myxœdema, and lipomatosis universalis asexualis.

ORDINARY OBESITY.

The treatment of this form is mainly a matter of diet. In all the successful systems which have been advocated for this purpose, *e.g.*, Banting's and Salisbury's, it is the fats and carbohydrates which are attacked. The patient is allowed to eat almost as much as he desires of nitrogenous foods, and is encouraged to drink large quantities of water. Of the efficacy of these systems there can be no doubt, but it is well to remember that in prescribing them in their full severity the physician is placing a very considerable strain upon the patient's kidneys and is pouring into the system the very substances which are believed, on good evidence, to favour high blood pressure and arterio-sclerosis. If, therefore, there is reason to suspect the integrity of the patient's constitution in these directions, the physician must content himself with endeavours to limit the whole quantity of intake, more especially of fats and alcohol, and to encourage the output by means of exercise in the open-air, Turkish baths, massage and courses of treatment at Marienbad, Vichy or Brides-les-Bains.

Exercises.—What may be called the stress of ordinary obesity is very liable to show itself more particularly in the abdomen. In such cases the muscles of the anterior abdominal wall will be found to be flaccid and atrophied, and an endeavour should therefore be made to re-educate them up to the normal standard. It is not sufficiently recognised that fat deposits itself with difficulty in the neighbourhood of well-developed, strongly exercised muscles, a rule to which the abdominal muscles afford no exception. Moreover, the flaccidity of these muscles permits of a sluggishness of the circulation in the splanchnic area which, by its retarding effect upon general metabolism, often supplies the key to the cause of a generalised obesity. To the development of these muscles the exercises, such as golf, which are usually considered suitable to the middle-aged, contribute little or nothing, so that exercises *ad hoc* are necessary. For example: Wearing as little clothing as the circumstances permit, and with the windows wide open, the patient lies on his back on the floor, with his feet under the opened lowest drawer of a chest of drawers or anything else which will keep his feet from rising from the ground. With his arms fully extended above his head and touching the floor in their whole length, he proceeds to pull himself into the sitting posture by means of his abdominal muscles, keeping the knees unbent. Care must be taken not to advance the arms beyond the line of the trunk and to perform the movement deliberately. This will be found a very trying discipline to those who are unaccustomed to use their abdominal muscles; indeed, it is to many quite impossible. In such instances it is wise to begin with a modification, which consists in allowing the arms to be crossed on the chest while the rectus muscles pull the trunk forward. This exercise should be done two or three times each morning to begin with; and when it can be done seven times without undue effort the arms should be placed above the head as first described. With the arms thus placed, the number of times must again be reduced and then gradually increased as before. Another exercise which may immediately follow on the foregoing is performed as follows: The feet are released from the chest of drawers, and, still lying flat on his back, the patient raises the fully extended legs until they are at a right angle to his trunk. While this is going on the hands are engaged in pinching up the skin and otherwise massaging the abdomen. These procedures may sound very formidable, but they are in reality not so. If they are done regularly, without hurry or strain, they take very little time and can do no harm, while their effect in keeping the figure from becoming aldermanic is very marked.

General massage and Swedish exercises, under the supervision of one who is fully trained, are very valuable, but the physician should be careful not to leave the selection of the operator or the "institution" to the patient. Very considerable harm has been done in the direction of provoking herniæ and other troubles by the vigorous measures in vogue at some fashionable institutes. The Zander Institutes at such spas as Vichy, Vittel, Evian and Aix-les-Bains are admirably adapted for these exercises.

Turkish baths and electric light **Baths**, inasmuch as they stimulate general metabolism, may be confidently recommended as useful adjuncts to the dietetic and general instructions.

So far as **Drugs** are concerned, it may be said that in the vast majority of cases they are unnecessary. Certainly, none should be prescribed with a view of directly affecting the obesity. Those which are permissible are such as will stimulate general metabolism and promote efficient secretion. The dyspeptic may require bismuth and soda, the constipated will be the better for a course of sulphate of magnesia reinforced with a weekly 5-gr. blue pill, while a diuretic such as ½ oz. of infusion of buchu in half a tumblerful of Evian water half an hour before each meal will be an advantage to all. But in cases of ordinary obesity it is wrong to give, as has too frequently been done in the past, drugs such as iodide of potassium and thyroid extract unless there is some state of the patient, other than the obesity, which clearly demands their exhibition.

Diet.—Whatever dietetic system be eventually determined upon, there are two points upon which the physician must insist. The one is that the intake of common salt be very seriously limited. In any really strict *régime* it should, indeed, be altogether forbidden for, say, the first fortnight. Later on, it may be allowed sparingly, but the quantity should never exceed 10 grammes, *i.e.*, about 160 gr. a day—distributed among the meals in any way the patient himself may prefer. The object of this limitation is twofold. It guards against that accumulation and stagnation of fluid in the lymph spaces which is so unfavourable to efficient metabolism, and prevents the too vigorous secretion of HCl in the gastric juice and so restrains appetite. Inasmuch as a salt-free diet is distinctly unpalatable, a further advantage is that patients are never tempted to exceed the prescribed quantity of food. The other point of importance which applies to all systems in the dietetic treatment of obesity is that fluids must be taken either half an hour before meals or an hour after meals; they must never be taken with meals. The omission of precise directions on this point is a frequent cause of unsatisfactory results in cases where the patient has attended scrupulously to the prescribed diet.

The Vegetarian System, originally proposed by Albu, and still much practised in France, consists in ordering a diet composed mainly of green vegetables, such as cabbage, spinach, turnip-tops, cauliflower, and the like, with the addition of eggs, cheese and milk. The underlying principle is that although the patient ingests a large quantity of material and is thus able to satisfy his appetite, the nutritive value of the diet is very small and weight is rapidly lost. The system is useful in cases where the kidneys or the arteries are under suspicion. It is one which appeals strongly to those who would invest uric acid with the responsibility for any and every morbid process; but it has the demerit of being barely tolerable to a large percentage of people. Moreover, unless the food values are very carefully controlled, the albuminous intake is liable to be reduced below the limits of safety.

The systems, such as Banting's, Salisbury's, or Ebstein's, which have from time to time found favour with the profession and the public, will be found fully discussed in the text-books on dietetics.[1] The scheme which here follows is one of moderate severity, and is not irksome to any reasonable patient. It should produce a reduction of at least 1 lb. per week.

Dietary, 8 *a.m.*—A tumbler of hot water, sipped, to which some fresh lemon juice may be added.

Breakfast, 8.15 *a.m.*—One small cup of tea or coffee sweetened with saxin or saccharin; no cream, no milk; 1 oz. dry toast; no butter; 4 to 6 oz. of lean grilled steak, chop or kidney, lean cold tongue, chicken, game, grilled or boiled sole, plaice, cod, turbot, brill, haddock, or whiting.

1 *p.m.*—Three-quarters of a tumbler of Evian, Vittel or Vichy water.

Lunch, 1.30 *p.m.*—3 to 4 oz. of lean beef, mutton, lamb, chicken, game, hot or cold, roast or boiled; gravy must be free from fat; 4 oz. of any vegetable as given below plainly boiled without butter, lard or oil; a baked apple, or 2 to 3 oz. of baked cherry or gooseberry, sweetened with saxin or saccharin only; salad, if taken, must be without oil or beetroot; two or three Wine Oliver biscuits; 2 oz. of toast; one glass of light wine, red or white; small cup of coffee, without sugar, milk or cream, but sweetened with saxin or saccharin.

5 to 6 p.m.—A cup or two of tea without milk or sugar and one Wine Oliver biscuit; half an hour before dinner three-quarters of a tumbler of any of the above-mentioned waters.

Dinner.—3 to 4 oz. of any fish, as at breakfast, and 4 oz. of any meat, as at lunch; if chicken or game is taken it must be without bread sauce, or crumbs; if less fish is taken the meat may be increased proportionately; 4 to 6 oz. of any vegetable as mentioned below, and 3 to 4 oz. of baked or stewed apple; rhubarb, cherry, or gooseberry sweetened with saxin or saccharin only; salad and biscuit as at luncheon; 2 oz. of toast; wine as at luncheon; a cup of black coffee with saxin or saccharin.

A cup of beef-tea may be taken at bedtime, but a tumblerful of any of the above-mentioned waters is preferable.

Condiments Allowed.—Worcester and anchovy sauces; ketchup, pepper, mustard, vinegar, walnut pickle, horseradish; not more than 160 gr. of salt may be taken per diem.

Salads and Vegetables Allowed.—Watercress, radishes, lettuce, cucumber, mustard and cress, spinach, asparagus, celery, brussels sprouts, cabbage of all kinds, cauliflower, broccoli, sea or Scotch kale, vegetable marrow, kidney or French beans, tomatoes, artichokes, endive, sorrel, salsify.

Anything not mentioned above may be assumed to be forbidden.

OTHER FORMS OF OBESITY.

Of the remaining types of obesity it is not necessary to enter into any detail concerning the treatment of **Anæmic Obesity** or **Toxic Obesity**, for in each case the discovery of the cause points unmistakably the proper measures to be adopted. On the subject of **Internal Secretory Obesity**, much that is highly suggestive has been written, especially in France, but more clinical experience is required before the matter can be placed upon a firm basis for therapeutic purposes. It is well, however, even in the present state of our knowledge, that the physician should bear in mind the considerations which connect the activities of the internal secretory glands with the development of obesity, so that he may be in a position to make trial of the appropriate remedies. These considerations may be stated briefly as follows.

The absence or inactivity of the genital glands in both sexes is a recognised cause of obesity, not only in man, but in the lower animals, *e.g.*, oxen and capons. Double ovariotomy is almost invariably followed by obesity, and the cessation of ovarian activity at the menopause gives rise to a similar result. Unduly fat children of the male sex will be found on examination to have very small testicles, and the type of obesity described by Jonathan Hutchinson as lipomatosis universalis asexualis is associated, as the name implies, with complete sexual impotence.

Absence of the thyroid secretion gives rise to cretinism in infancy and myxœdema in adult life, both of which diseases, even if they be not accompanied by true obesity, which they often are, are characterised by a state of the tissues which may easily be mistaken for obesity. Insufficiency of the thyroid secretion which falls short of complete absence is often associated with a similar condition of pseudo-obesity, a deposit, that is, of such large quantities of mucin in the tissues as to simulate very closely the appearance of general obesity.

The relations between disturbances in the activity of the pituitary body or hypophysis cerebri to obesity, or some such state of pseudo-obesity as is seen in thyroid inadequacy, are very decided, but it is not yet possible to define them. Whilst, on the one hand, as shown by the German surgeons, ablation of the pituitary body invariably gives rise to emaciation, on the other, it has been proved that the subcutaneous injection of pituitary extract determines the disappearance of superfluous fat.

When more is known about the inter-relations of the various internal secretory glands it may be possible to write with some precision as to the responsibility which each may bear in the production of obesity. At present it is only possible to direct further attention to the matter and to sound a note of warning in the employment of remedies which may seem appropriate. Thyroid extract ought not to be exhibited unless, in addition to the obesity, the patient presents some of the stigmata of thyroid inadequacy. The usually quoted dose of the dried extract (*i.e.*, 5 gr.), three times daily, is more than ten times too large. Under no circumstances, where the patient is suffering from any condition approaching to obesity, should the initial dose exceed ½ gr. twice daily. During the exhibition of the remedy a very careful watch should be kept on the pulse rate and temperature. Pituitary extract, of which the usually quoted dose of 2 gr. when given by the mouth is usually too small to produce any results, has in doses of 8 to 10 gr. a day a marked effect in stimulating the unstriped muscular tissues, and in this way of raising the blood pressure. It should consequently never be prescribed for those who on examination with the manometer display any tendency to high blood pressure.

LEONARD WILLIAMS.

Reference.

[1] *See* "Food and the Principles of Dietetics," by Robert Hutchinson (Arnold, 1900), pp. 480 *et seq.*

SCURVY AND INFANTILE SCURVY.

It is now generally admitted that scurvy in children is the same disease as has long been recognised in connection with adult life. The term infantile scurvy is useful as indicating the period of childhood at which scurvy is most common, and also that the symptoms at that age are different from those met with in later years. The diagnosis is not difficult, as a rule; but one point must be kept in mind, namely, that hæmorrhage may be limited to one organ or region of the body. For example, hæmaturia may be the only obvious sign. The disease is essentially a dietetic disorder, and the fault lies not in excess of food, but in the use for a prolonged period of a dietary which does not contain a sufficient amount of the antiscorbutic element.

The Preventive Treatment is of the first importance, and consists in the employment of a dietary containing a sufficiency of fresh food. Breast milk fulfils this requirement, and so does fresh cows' milk. It may safely be stated that infants fed on such food will not develop scurvy, whatever other troubles they may be liable to. Similarly after the period of infancy, if a child has a sufficient amount daily of fresh foods containing the antiscorbutic element, such as cows' milk, potatoes, green vegetables, and fruits, the risk of scurvy need not be feared any more than it is in adult life. By the term fresh milk (cows', goats', or asses'), we mean milk which has not been tampered with in any way or allowed to undergo fermentative changes. For family use cows' milk may be boiled or pasteurised or sterilised, and it must be recognised that the heating of milk diminishes the antiscorbutic qualities in proportion to the temperature reached and the length of time it is continued. The ordinary domestic method of boiling the milk for a few minutes does not appear to injure appreciably the antiscorbutic value of the milk, as common experience shows. On the other hand, prolonged pasteurisation of the milk has undoubtedly led to the development of scurvy in some cases, and cannot be regarded as a reliable dietary from this point of view. Sterilised milk is much more dangerous, and many cases of scurvy have been traced to its exclusive use. While the domestic pasteurisation or sterilisation of milk has never become very common, and is daily becoming rarer, a new danger has arisen from the fact that dairy owners are now supplying milk which has been pasteurised or sterilised in bulk. While this is sometimes done openly and sometimes secretly, the main object is to enable the milk to "keep" better, and the result is that it often reaches the customer with very little freshness left and with its antiscorbutic properties much diminished. If in addition it is boiled on delivery by the careful householder, there will not be much freshness left by the time it reaches the infant. For these reasons milk which has been pasteurised or sterilised at a dairy cannot be regarded as a safe food for infants, and only fresh, untouched milk should be purchased. A still greater risk is run in connection with the exclusive use of patent and proprietary foods. All of these in the process of preparation have the antiscorbutic property destroyed by heating or keeping. This danger has been so often pointed out that now some of the makers issue printed instructions as to the addition of antiscorbutic material in the shape of fruit-juice, etc. These instructions may or may not be carried out, and in the case of infant life it is better to run no risks. In the preventive treatment of scurvy it is advisable to abolish all tinned foods, whether milk or cereal or albuminoid, and to use fresh foods only. There would be very few cases of scurvy in this country if the use of tinned foods was restricted to cases of illness (under medical supervision), or as a brief temporary substitute for fresh cows' milk.

The Curative Treatment of scurvy leads to some of the most striking results in the region of therapeutics. The pains and weakness of the limbs vanish quickly, the languor and anæmia are ameliorated, and the hæmorrhages cease, provided that the disease has not advanced too far. The first essential in the case of infants is to change the dietary to one of fresh milk exclusively. It may be stated by the mother that the infant has been taking fresh milk along with a patent food, but on investigation it will be found that only a small quantity of fresh milk had been given daily. What the infant wants is from 25 to 30 oz. of pure, fresh milk daily, provided that the digestive organs are sufficiently sound. After a week or ten days farinaceous food may be added to the diet if suitable to the age of the child.

In order to secure as rapid recovery as possible some special antiscorbutic food should be given. Grapes, oranges and potatoes are the most suitable means. The juice of a dozen grapes or half an orange, diluted with water, may be given daily. For older infants, boiled and sieved potato mixed with milk is a most effective antiscorbutic. It is often very striking to observe the avidity with which an infant will take these special antiscorbutics, although in some cases quite an antipathy to them is manifested, an aversion which is apparently constitutional. Care must be taken that in the weakened condition of the digestive organs which is usually present, the amount of antiscorbutic food is not pushed too rapidly, as troublesome diarrhœa sometimes arises from this cause. In the case of older children all the ordinary green vegetables may be given freely as part of the antiscorbutic diet.

When extravasations of blood have occurred about the long bones the infant should be kept reclining and be disturbed as little as possible, so as to prevent the severe pain which any movement brings and the occurrence of fractures, which are easily induced. The tender limbs should be swathed loosely in thick folds of cotton-wool. Hæmaturia does not call for any special treatment, and the symptom rapidly passes off under antiscorbutic diet. Raw meat-juice is recommended by some for the anæmia which is usually present, and may safely be given, but as a rule it does not seem to be required under a proper milk diet with antiscorbutics. The bowels should be carefully regulated by means of castor oil, and if a tendency to diarrhœa is present, 2 or 3 drops of paregoric may be added to each dose. In some cases prostration is a marked feature, and in all cardiac syncope is a danger which must be kept in mind. Stimulation by means of brandy and strychnine may be called for. After the subsidence of acute symptoms, cod-liver oil and malt will prove beneficial, especially as rickets is so frequently associated with scurvy.

After the age of infancy scurvy is an extremely rare condition under the ordinary conditions of life, and it will usually be found that the condition is associated with a strong dislike on the part of the child to vegetables and fruits. If there has been a diet limited to bread and butter, puddings, tea, and perhaps a small quantity of milk, scurvy may develop, either in an acute or a chronic form. Usually treatment by fruits and vegetables will quickly remove the acute symptoms. Instructions should be given for the continuance of a proper diet in order to avoid the risk of relapses.

G. A. SUTHERLAND.

RICKETS.

In the treatment of rickets dietetic, climatic, hydrotherapeutic and hygienic measures are of chief importance, drugs taking a secondary place. Special methods are needed for the prevention and cure of deformities.

The infant should be out in the open-air as much as possible, and live in rooms which are well ventilated and get plenty of sunshine. Country air is better than that of towns. There is no special virtue in the air of the seaside or high altitudes except in so far as it stimulates the appetite and metabolism. On account of the liability to respiratory affections preference should be given to residence in a warm, dry climate, and houses built on gravel or sandy soil. Low-lying, damp and marshy places and houses surrounded by trees are unsuitable. Exercise is of great value. Experiments by Findlay showed that birds and animals kept in cages often became rachitic in spite of sun and fresh air. He could induce the disease in puppies by confinement alone, but not by any kind of diet if they were allowed free exercise. Oxidation and carbonic acid excretion are diminished by confinement. Hence it is advisable to encourage free movements of the infant's limbs, during the bath and at other times, and not to limit them by heavy swaddling clothes.

Hydrotherapy helps to reduce the patient's liability to catarrh and stimulates the circulation. A daily bath should be given of sea-water or of salt and water, using 1 oz. of rock-salt to 2 gallons of water. If the skin is irritable, starch (1 oz.) and sod. carb. (1 drachm) should be added. Such a bath should be given at 95° F. for fifteen minutes to infants under six months of age; or at 70° to 80° F. for a few minutes to older infants, and followed by dry rubbing. Or a cold douche, with the child sitting in a warm bath, can be used, and should be followed by massage. Care must be taken not to do harm. If the child is blue and chilly after the bath the treatment is injurious.

Clothing.—At night the child should wear pyjamas and socks, or a night-dress of soft wool or flannel, tied below the feet, because of the frequency with which he throws off the bedclothes. The pillow must be low and firm, and the mattress smooth and hard, preferably made of hair. In the day-time the clothing must be light. No tight garments which interfere with respiratory movements should be allowed. A moderately firm abdominal binder is permissible, if there is much flatulent distension.

The diet must be liberal and contain a sufficient amount of proteins and fats. If breast-milk is unavailable, a modified cow's milk should be given. For this purpose either the top half or top third of the milk, after it has stood in the cold for two to four hours, may be used, so as to make sure of a sufficiency of fat in the mixture when it is diluted. This is preferable to adding bought cream or even the cream obtained by skimming. The present state of our knowledge indicates that deficiency of fat in the diet, or some error in the absorption and metabolism of fat, is the main dietetic factor in the causation of the disease. It is also essential that the diet contain a proper amount of protein and no excess of carbohydrates. Indeed it seems that an excess of starch can set up rickets in infants who are having a sufficiency of fat, possibly by interfering with the metabolism of fat. Even after the age of six months, when rickets begins to show itself, the amount of starch in the diet must be limited and only slowly increased. Yolk of egg is a valuable addition. After the age of twelve months the child can have fat in the shape of butter, margarine, bacon or beef dripping, and brains.

Digestive Disorders are often due to unsuitable food or to alimentary catarrh. If severe and prolonged, the resulting state of marasmus may mask the rachitic element. This intestinal derangement produces the "pot-belly" or "frog-belly," by reason of the flatulent distension of the gut, the weakness of the abdominal muscles, the everted lower ribs, contracted thorax and flat pelvis. In such cases the amount of carbohydrates, especially sugar, must be reduced. Hyd. c creta (½ gr.) should be given every one or two nights; and a mixture of sod. sulphocarb., 3 to 5 gr.; tr. nuc. vomicæ, ½ to 1 min.; tr. rhei co., 5 to 10 min.; ol. ricini, 10 to 15 min.; liq. calcis ad 1 drachm, ter in die. There is no advantage in giving lime-water except as an antacid. It contains much less lime than cow's milk does, and apparently in an inorganic inassimilable form.

Drugs.—Cod-liver oil should be given as soon as the state of the alimentary canal warrants its exhibition; otherwise it is apt to set up diarrhœa. It may be given alone or as an emulsion, in small doses three times daily after meals, except on Sundays, and continued for several months. Suitable mixtures, of which the dose for a year-old infant is 1 drachm, may be quoted: (1) Ol. mor., maltine, syr. fer. phosph. co., p.a. (2) Ol. mor., liq. calcis, syr.

calc. lactophosph., p.a. (3) Calcium and sodium hypophosphit., āā ½ gr.; ol. mor., glycerin., āā 20 min.; ol. cassiæ, $\frac{1}{100}$ min.; mucil. tragacanth., ad 1 drachm. (4) Ol. mor., syr. calc. hypophosph., liq. calcis, āā 18 min.; sodium hypophosph., 1 gr.; ol. cassiæ, $\frac{1}{25}$ min.; mucil. acaciæ, ad 1 drachm. (5) Ol. mor., 2 oz.; maltine, ½ oz.; syr. calc. hypophosph., ½ oz.; glycerin., 2 drachms; pulv. acaciæ, 2 drachms; aq. cinnamomi, ad 4 oz. Or the oil can be given in various combinations with glycerine, lime-water, syr. aurantii, aq. carui, maltine and vin. ferri. Other oils are useful, but not as good as cod-liver oil. Although phosphates, lactophosphates and hypophosphites are recommended, there is no certain proof that they are beneficial. Phosphorus has been strongly recommended by Kassowitz as "the iron of rickety children." It is given in drachm doses daily of mixtures such as: Phosphorus, 1 gr., in ol. amygdal. dulc., 21 oz.; 1½ gr. in ol. mor., 40 oz.; 1 gr. in white sugar, 6 oz., ol. amygdal. dulc., 15 oz., spirit menth. pip., 15 min.; or 1 gr. in white sugar, 3 oz., gum acaciæ, 3 oz., lipanine, 6 oz., water, 9 oz. Glycerophosphates are also used. Possibly the deficiency of fat in the diet leads to deficient absorption of phosphorus, and additional inorganic preparations make up for the defect. Personally I prefer to rely on the organic compounds of phosphorus in the yolk of eggs, the hard roe of fishes and in calves' brains.

If there is any convulsive tendency sodium bromide should be added to the cod-liver oil mixture. Iron and arsenic must be prescribed for anæmia. Adrenalin is said to exert a favourable influence on craniotabes, sweating, nervous manifestations and the general condition. For profuse sweating at night, I prescribe tonics, a dose of atropine or tr. belladonnæ at bedtime, and sponging with tepid water.

Special Measures.—To encourage aëration of the blood free ventilation is essential. Causes of respiratory obstruction, *e.g.*, adenoids and large tonsils, must be removed. Respiratory exercises are injurious, for the chest wall sinks in during inspiration, owing to the softness of the cartilages.

Once the disease has commenced, efficient treatment will prevent disastrous results. Apart from that, serious deformities develop. The tendency to kyphosis is counteracted by not allowing the child to sit up, or at any rate by not encouraging it to do so. It is absurd to keep a mild case entirely on the back or lying down, so the amount of sitting up must depend on the severity of the disease. If there is kyphosis the dorsal decubitus must be insisted on for most of the day, with intervals during which the spinal muscles can be exercised and massaged. For a few minutes daily the child must be laid on its belly, with the buttocks elevated, and gentle pressure applied to the spine. In severe cases a spinal support may be worn to enable the child to sit up for short periods of time, but it must not be kept on continuously. The spinal muscles must be strengthened by massage, and by exercises when the child is old enough. Sitting must be prohibited in active rickets, especially in girls, because of the liability to pelvic deformity and subsequent difficulty in labour.

Bowing of the legs is due to the softened bones and lax ligaments being unable to maintain the weight of the body in standing and walking; as the weight is often out of proportion to the age of the child, in consequence of too liberal a carbohydrate diet. The child must be kept off his legs and the limbs massaged. For this purpose external splints of uneven length, extending 2 to 3 inches below the soles, should be applied, in order to render standing difficult. Poroplastic splints help to cure curvature of the tibia when properly applied. The splint must extend from a little above the knee to the ankle, and be fastened by straps round the ankle, below the knee, and round the middle of the calf. The last strap is the most important. It is fastened round a square leather pad on the outer side of the calf and is tightened daily. Such a splint is easily put on, can be kept clean, and does not interfere with exercise. External splints must be worn at night, if the limbs are curled up in bad positions.

If the child is kept off his feet he is apt to crawl on the hands and knees and exert undue pressure on the upper limbs. The treatment is most suitable when the disease is stationary in the upper limbs. Deformity of the upper limbs is less important than in the lower ones. It is rarely severe and generally gets well. The natural tendency of bone during growth is to resume its normal shape. A midday sleep in bed and prolonged recumbency on the back in a suitable perambulator or spinal carriage help to keep the child off the feet. Slight bowing of the lower limbs requires no treatment by splint, unless it is progressive. A tracing of the limbs on paper should be taken at the first examination and compared with subsequent ones. Memory and judgment are not sufficiently reliable guides to the degree of progress.

Knock-knee is best treated in early stages by massage and an external splint, with a certain amount of pressure exerted by a bandage over the knee. In late stages surgical measures are needed. Osteotomy, for the cure of rachitic deformity, should be postponed until the seventh year, for many bad cases recover with practically normal limbs. Flat-foot must be treated by massage of the limbs, exercises, and a boot with the sole thickened on the inner side.

EDMUND CAUTLEY.

RHEUMATISM (CHRONIC).

This term has been used so loosely to describe almost every kind of affection of joints and muscles that it is necessary first to define as briefly as possible the conditions to which it may reasonably be applied, and to emphasise the importance of distinguishing them from rheumatoid arthritis and other conditions having similar symptoms, but differing in pathology and treatment. Two general types may be recognised, namely, fibrositis and synovitis. Fibrositis is an inflammation of the white fibrous tissues characterised by exudation and proliferation of the connective tissue elements, which may go on to absorption and cure, or to organisation with the formation of nodules and patches of thickening where the muscle sheaths and similar structures are affected, or general induration of the ligaments or capsules of the joints. The wide distribution of this form of connective tissue through the body renders a great variety of structures liable to fibrositis, but the usual sites of the affection are joint capsules, ligaments, muscle sheaths, tendons and aponeuroses, bursæ, periosteal structures and nerve sheaths. Synovitis, which is perhaps more often due to trauma than to any cause which may be regarded as rheumatic, affects the synovial membranes of joints, bursæ and tendon sheaths, and gives rise to thickening and overgrowth of the synovial membranes with the formation of adhesions between the opposing surfaces and hypertrophy of the synovial fringes. There may be much exudation of fluid within the cavity, or more commonly in the rheumatic type there is little exudate or even a deficiency in the normal supply, causing creaking or grating perceptible to touch and often audible to the patient and even to those around when the joint is moved. Stiffness and pain when movement is attempted characterise both synovitis and fibrositis, and these may be regarded as the cardinal symptoms of chronic rheumatism, though pain when at rest is not uncommon. Bony changes do not usually occur, though small osteophytes are sometimes found, especially in cases due in some measure to wear and tear of the joint. Some confusion with osteo-arthritis may thus arise, and it is possible that osteo-arthritis may develop in the later stages of some cases, but the essential difference lies in the non-affection of the cartilages in chronic rheumatism. It is essential also to distinguish carefully the synovial affections from rheumatoid arthritis.

Chronic rheumatism of joints is met with in its most typical form in the knuckle joints of farmers and those who are obliged to work in damp surroundings; it is also seen as the sequel of acute rheumatism, but rarely now that salicylates are used. The ligaments are thickened and movement is restricted, but the X-rays show that the cartilages are unaffected. In the knee joints chronic rheumatism is extremely common, but tends to synovitis rather than fibrositis, and is very frequently regarded as osteo-arthritis, an error which it is important to avoid on account of the difference in prognosis and treatment. This form is most common in women about middle age, and varicose veins or other conditions interfering with the circulation of the legs are an important predisposing cause. The creaking and grating which are conspicuous symptoms are due to the synovial condition and not to bony change as is frequently supposed, and if there is much hypertrophy of the synovial fringes they may sometimes be caught between the articular surfaces and cause locking of the joints or even a sudden fall. Another form which is worthy of special mention is chronic rheumatism of bursæ; the bursa which separates the acromion process and deltoid muscle from the tendons of the supraspinatus and subscapularis and the head of the humerus is most commonly affected. Severe pain and limitation of movement in the direction of rotation and abduction are the chief symptoms, and it is important to distinguish it from brachial neuritis, the diagnosis depending chiefly upon this peculiar restriction of movement and the absence of any marked tenderness along the nerve trunks. It must be noted, however, that fibrositis may extend from the bursa to the adjacent nerve trunks and thus neuritis be caused.

Chronic rheumatism of aponeuroses and muscle sheaths is usually the sequel of an acute fibrositis, and is known as muscular rheumatism, under which heading its treatment will be dealt with. Rheumatism of the occipital and pericranial aponeuroses is a common form of headache.

The principal causes of chronic rheumatism are exposure to cold and damp; strains of muscles and tendons and slight injuries of a similar nature to joints; and the action of toxins, especially those of acute rheumatism, influenza, gonorrhœa, etc., or those derived from putrefactive processes in the intestinal tract. In the latter case mucous colitis also is sometimes present, the two conditions being the result of a common cause, namely, the production of toxins in the bowel by abnormal bacterial activity.

Exposure to damp and cold being such important causes, the first line of treatment must be to improve the conditions in this respect where they are defective, and where a change of climate to one more suitable is possible it should be obtained. Dryness is of the first importance, a cold, dry climate being preferable to a hot one which is moist, while warmth and dryness constitute the ideal.

The subject of chronic or muscular rheumatism should never sleep in ground floor bedrooms, and care must always be taken that the ground on which the house is built is concreted and that there is free ventilation between the floors of the rooms and the ground. Instances have been known of houses where the inhabitants have constantly suffered from chronic rheumatism until these precautions were taken, when a marked improvement at once took place. Where possible, residence on a clay soil should be avoided, and in any case care must be taken that the soil is properly drained. A hillside is better than the bottom of a valley on account of the natural drainage provided. It must also be noted that a gravel soil may be enclosed in a basin of clay, and thus form a natural reservoir of subsoil water which may reach to within a very short distance of the surface and thus be even less desirable than clay. Residence near any pond or large sheet of water is undesirable.

Clothing is of much importance, and the question of wool or woven linen garments next the skin is one on which great differences of opinion exist. Woollen garments protect the skin from changes of temperature, but if too numerous or heavy they prevent the evaporation of perspiration and keep the body in a constant atmosphere of high humidity and, further, undue protection of the skin reduces its power of reacting to changes of temperature through its vasomotor mechanism, and a valuable method of conserving the body heat is partially or entirely lost. Woven linen permits free evaporation of perspiration and keeps the skin dry, but at the same time it affords little protection against sudden variations in the outside temperature, cold winds, etc. Individuals, therefore, who perspire freely, but who are not unduly exposed to the weather, may find linen preferable, but for most rheumatic subjects wool is safer. I personally consider that a single woollen garment should be worn next the skin, and the outer garments should be as light and loosely fitting as possible. Whenever free perspiration has occurred the underclothing should be changed for dry garments as soon as possible; clothing damp from such a cause is a more potent cause of rheumatism than is commonly realised.

Diet.—There is some reason to believe that excess of carbohydrates, and especially sugar, is injurious in fibrositis, and therefore pastry and sweets should be avoided and sugar restricted. In cases where there is evidence of intestinal fermentation this should receive special attention, since there is ample evidence to show that absorption of toxins thus produced may give rise to various forms of rheumatism, and any tendency to constipation must also be dealt with and the diet regulated accordingly. A careful consideration of the patient's general habits, together with examination of the urine, will point out the line of diet required. In some cases restriction of carbohydrates may advantageously be carried to a considerable degree, the diet consisting of beef, mutton, chicken, and fish, eggs, cheese, green vegetables, fruit without sugar, butter, cream, etc., a small amount of carbohydrate in the form of toast, boiled rice, etc., being allowed. There is no ground for the preference commonly given to fish and white meat over red meat, except in so far as they are easier of digestion.

The Salisbury dietary carries this idea to its extreme and consists of minced beef taken at three or more meals in quantities from 2 to 6 oz. or more at each; in its strictest application no other food is allowed. Four pints or more of hot water are taken in the day, generally in doses of 1 pint an hour before each meal and at bedtime. So rigorous a diet is, however, rarely if ever required in the diseases under consideration, and it is usually modified in some degree.

Where intestinal fermentation is present to any degree or if there is a gouty tendency, an entirely different dietary may prove more successful, aiming at reduction of the purins contained in the food. This object is best attained by a diet of which milk is the basis, to which may be added fruit, vegetables, cheese, butter, and the usual carbohydrates, little or no meat being permitted.

External Applications.—*Heat* is one of the most valuable external applications in the various forms of chronic rheumatism. It acts by dilating the blood-vessels of the part and thus causing an increased flow of blood and lymph which tends to carry away toxins and to facilitate the absorption of indurations. It may be applied by means of hot linseed poultices or fomentations, hot water bottles, or flannel bags containing salt, which may be heated in the oven and then applied. The value of poultices or fomentations may be enhanced by previously painting the part with iodine, which appears to be vaporised by the heat and absorbed, thus exerting a definite effect in promoting absorption of inflammatory material. Occasionally, however, it may cause a slight dermatitis where special susceptibility exists, but this readily yields to a simple lead lotion. I have found this method very useful in chronic synovitis of the knees and in chronic fibrositis of rheumatic origin.

In more obstinate cases the use of superheated air by means of one of the various forms of apparatus devised for this purpose is necessary, and such apparatus may now be obtained in a simple portable form designed for use with the heat derived from one or more bunsen burners, and may thus be used in the patient's home. Probably, however, the heat combined with light rays obtainable from incandescent electric lights is more effective as well as safer, where it is available. Other methods are vapour baths and hot mud packs, the former being well adapted for treatment of the whole body, as are also electric light cabinet baths. These various methods of applying heat are all more effective when used in conjunction with other methods, especially massage, as is customary in spa practice, and there is no doubt that spa treatment offers the best chances of recovery in all cases of any severity.

Liniments for rubbing into the affected parts are weapons of much importance in the treatment of these conditions, and may be divided into two groups, those designed to relieve pain and those whose chief object is to assist absorption. For the relief of pain I prefer the various salicylate preparations, such as mesotan, salit, etc. Mesotan has the drawback of producing a dermatitis in some individuals, and should always be used diluted with one or more parts of oil or vaseline; the latter is said to lessen the risk of irritation. I have, however, found salit more generally useful, though it seems to have a greater vogue on the Continent than in this country; it may also be diluted with an equal quantity of olive or almond oil. Other preparations of methyl salicylate are obtainable and have a similar action, and to this category may be added a combination of equal parts of camphor, chloral hydrate and menthol, which when rubbed together form a cream. They are best applied by painting them over the affected part and then rubbing in with very gentle friction, or they may be covered with oil-silk and cotton-wool without using any friction. Some cases find more relief from the aconite [U.S.P. fluid-extract of aconite] chloroform and belladonna liniment, and this should always be tried if the others fail.

For promoting the absorption of exudates the most useful applications are preparations of iodine, and these require to be well rubbed in to facilitate absorption, the rubbing also serving to dilate the superficial blood-vessels and to promote freer circulation in the part affected. The liniment of iodide of potassium and soap [U.S.P. Saponis, 13·50; Potass. Iodid., 10·125; Glycerin., 6·75; Ol.

Limonis, 0·844; Aquæ Dest., 67·5] is one of the most useful, and if persevered with for a long period of time often effects the absorption of the nodules and thickenings round the joints in a most satisfactory manner. Other preparations having a similar effect are the combinations of iodine with oleic acid, which are obtainable under various proprietary names, and "jothion," is another proprietary article containing a very high proportion of iodine, which may be used diluted with an equal weight of olive oil with excellent results in many cases.

One of the most valuable methods at our disposal is *ionisation*, with salicylate of soda in painful conditions, or with iodine or iodide of potassium or lithium where absorption of exudation is the object it is desired to attain. Leduc finds that chloride of sodium produces effects in the direction of absorption of fibrous induration equal to those of iodides, but this has not so far been my experience. In painful conditions a pad of some ten or twelve thicknesses of lint sufficiently large to cover the painful area is soaked in a 2 per cent. solution of salicylate of soda and an electrode applied over it connected with the negative pole, while the positive pole is similarly connected to another pad soaked in a weak saline solution and a current of 30 to 60 milliampères, or even more, is passed for from ten minutes to half an hour or longer. If, on the other hand, it is desired to introduce iodine ions the most convenient plan is to paint the skin with iodine and apply a pad soaked in a weak solution of carbonate of lithium with an electrode connected with the negative pole, the positive being applied as before. In either case it is advantageous to apply previously superheated air by one of the methods already referred to, the increased circulation thus produced greatly facilitating the carrying of the ions driven through the skin throughout the affected area. I think that the effect produced is probably in some measure due to the action of the electric current itself entirely apart from the drug employed, and this may account for the good effects obtained by Leduc with chlorine ions. I am strongly of his opinion, however, that it is important to use a pad of sufficient thickness and as much current as the patient can bear.

Electricity.—This is a mode of treatment which has been tried in every conceivable form, but my own experience has led me to the conclusion that, with the exception of the method just described, better results may be obtained by other means.

Massage.—This is one of the most valuable methods at our disposal in chronic fibrositis, and will be referred to more fully in discussing the treatment of muscular rheumatism. It is often advantageously preceded by the application of superheated air by the means already described, and in spa treatment the use of hot douching is also combined with considerable advantage; the Aix douche, which embodies this principle, has become widely known and adopted. It is necessary, however, to point out that massage must not be used indiscriminately in all forms of chronic rheumatism. In chronic rheumatic or villous synovitis it must not be used to the affected joints but only around them, aiming at improving the circulation in their neighbourhood, since congestion of the joint structures, such as may be caused by varicose veins, is often a factor in the case. Massage applied to the joint itself only succeeds in bruising the synovial fringes and increasing the inflammation. The same applies to rheumatism of bursæ and tendon sheaths, but in the later stages of these conditions gentle stroking movements are of value, and judicious massage on these lines will help to prevent the formation of adhesions. Fibrositis of nerve sheaths is also unsuitable for massage until the later stages, when it may serve to dispel passive congestion and to break down or to prevent the formation of adhesions.

Exercise.—The use of passive exercises as well as of active is necessary in those cases of chronic fibrositis and periarthritis where there tends to be considerable limitation of movement. It is a good plan to carry out daily systematic exercises designed to stretch the fibrous tissue around the joints, aiming each day at attaining a slightly greater range of movement, and keeping up the exercises for long after the full range has been attained to counteract the tendency of such tissues to contract; from neglect of this I have many times seen joints relapse without any sign of fresh rheumatism into as great a degree of stiffness as at first.

Rest.—It must, however, be emphasised that nothing is to be gained, but rather the reverse, by exercise in the acute forms of fibrositis, such as muscular rheumatism in early stages and in synovial affections; indeed in the latter, especially where the knees are affected, the more complete the rest the better the result will be. I have had very good results in such cases from the use of leather splints, which restrict the use of the joint generally to a very considerable degree without entirely disabling the patient. Such splints should be worn for at least three months and often for longer, being taken off at night and the joint moved gently through its full range of movement a few times. Rest is also essential in rheumatic bursitis, especially when the subacromial bursa is affected; the arm must be kept in a sling during the day, and at night the most comfortable position will often be found to be one of abduction so far as it can be carried out. The limb must, however, be moved throughout its whole range of movement daily, a procedure which may be difficult on account of the spasmodic contraction of the muscles whose tendons form the floor of the bursa, but unless such movements are carried out troublesome adhesions may form and leave the shoulder permanently stiff; in the later stages massage may advantageously be combined with the movements.

Drugs for internal administration find little scope in the treatment of chronic rheumatism. Aspirin or one of the many forms of acetyl salicylic acid often relieves pain and may be given in doses of 10 or 15 gr. three times a day, and also in the night if sleep is interfered with. Iodides are sometimes useful, but more often disappointing; they require to be given for a long time to be of any service, and in view of their depressing effect I generally combine them with quinine in a cachet or effervescing mixture, *e.g.*: ℞. Potassii Iodid., gr. 5; Potassii Bicarb., gr. 30; Glycerin., ♏30; Aq. Menth. Pip., ad ℥j. ℞. Quinin. Sulph., gr. 2; Ac. Citric., gr. 20; Aq. ad. ℥ss. *Sig.:* To be mixed and drunk while effervescing.

Where there is any digestive disturbance one of the various forms of iodine in organic combination may be used, such as iodipin, iodalbin, iodoglidine, etc., combined with quinine in a cachet.

Of other drugs perhaps the most useful is guaiacum resin, which may be given in such form as the "Chelsea Pensioner," combined with sulphur or with quinine or cimicifugin, a drug which is also worthy of a trial either in this form or as the tincture of cimicifuga. Ammonium chloride has also been recommended and is sometimes of benefit.

In this connection the use of fibrolysin may be referred to; it is a compound of thiosinamin and salicylate of soda, and may be obtained in the form of ampullæ, the contents of one being an ordinary dose. It should be injected preferably into the muscles; it is not necessary to inject at the affected part, the buttocks or deltoid muscle being the best sites. It should be given every second or third day, and generally at least thirty injections are required. Massage and movements must be used in addition and kept up for some time after the injections have ceased; exercises should be persevered with in the case of stiff joints for at least twelve months, or the fibrous tissues may contract and the condition become as bad as ever. Dupuytren's contraction of the palmar facia, which is of the same nature as fibrositis, is best treated in this way. More recently compounds of iodine with thiosinamin have been introduced, and should on theoretical grounds be of more value; one of them, iodolysin, is put up in ampullæ for injection, in capsules for administration by mouth, and in the form of ointment for inunction, a form which appears to present many advantages.

Spa Treatment.—A large proportion of the cases of chronic rheumatism are most advantageously treated at spas, where a wide range of methods are available which need not be detailed here; it is sufficient to say that they comprise the application of heat by means of vapour baths, packs and baths of peat or mud of various kinds, etc., and hot immersion baths and douches, with or without massage. The group of thermal radio-active springs have obtained a great reputation in the treatment of this class of case, their diuretic and alterative effect when drunk powerfully assisting their action when applied externally. The recent researches of His and others have shown that the action of these waters is due to their radio-active qualities, the urine and breath becoming radio-active when the waters are drunk, while rheumatic and gouty deposits are rapidly dispersed. Bath and Buxton are equal to any of the continental spas of this class, but Wildbad and Gastein may also be mentioned. The saline springs of Droitwich are very effective in some cases, and the same may be said of the bromo-iodine springs of Woodhall Spa. Where there is much intestinal putrefaction Plombières douches are of value and may be obtained at any of the leading British spas and on the Continent at Plombières and Châtel Guyon. The sulphur springs of Harrogate, Llandrindod, and Strathpeffer are also useful in some cases, while on the Continent Aix-les-Bains and Wiesbaden are among the best for these forms of rheumatism.

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RHEUMATISM (MUSCULAR).

This form of rheumatism, owing to its common occurrence and well-marked clinical features, requires special consideration, although what has been said as to the pathology of fibrositis in general applies to it also. It is, however, commonly met with at the outset in an acute form and only becomes chronic if neglected; owing to the pain and disability it causes however, it receives prompt attention as a rule, and chronic forms are much less common than in the case of joints. It is most commonly met with in the muscles of the back, the shoulders and neck, and the intercostal muscles, and in these regions is known respectively as lumbago, stiff-neck and pleurodynia. It affects the muscle sheaths, tendons and aponeuroses, from which it may spread to other fibrous tissues in the neighbourhood, such as nerve sheaths, as not infrequently occurs in the case of lumbago and sciatica. The common causes are exposure to cold and damp, and the action of toxins, such as cause the chronic forms of rheumatism, while trauma or over-fatigue may be the immediate exciting cause in some cases. The onset is usually acute, some sudden movement being followed by sharp pain, the patient sometimes being unable to return to his former position or to complete the movement owing to the pain caused. There may be slight fever and general malaise, and the muscles affected are often tender; the pain is usually only felt on movement and is absent so long as perfect immobility is maintained.

Rest is desirable in the early stages and is best taken in bed with light diet, but if there is no fever and the symptoms are not severe the application of strapping plaster to the affected area may suffice to secure the rest required. In the case of lumbago or intercostal rheumatism the strapping should be applied in long strips of about 2 inches wide, each strip overlapping the preceding one by at least half its width and sufficient being used to cover the whole area affected and overlap some inches in each direction. Plaster which is self-adhesive is of no use as it becomes loosened by the temperature of the body; the kind known as hospital strapping spread on brown holland should always be used. In addition to the rest thus secured for the affected muscles, the plaster supplies warmth and protection. If the muscles of the shoulder are affected the arm should be carried in a sling, and except in the mildest cases rest in bed is desirable on account of the risk of the fibrositis spreading and involving the sheaths of the nerves of the brachial plexus, thus causing brachial neuritis.

Heat supplied by means of any of the methods described under the head of Chronic Rheumatism is especially useful in acute fibrositis of the muscles. While the patient is in bed hot poultices are of value or flannels wrung out of hot water and sprinkled with turpentine; either may be applied at intervals and followed by the use of hot water bottles or hot salt bags. An old-fashioned but often useful plan in lumbago is to cover the affected part with a layer of flannel or brown paper and iron the part firmly with a hot flat-iron, following as far as possible the direction of the veins. This combines the effect of heat and massage and often gives great relief.

Drugs.—At the outset 3 or 4 gr. of blue pill should be given, followed by a saline draught. Free perspiration is of advantage if the patient is in bed, and often results from the use of the hot applications referred to, together with the administration of salicylates, which are of value at this stage. Salicylate of soda in doses of 15 or 20 gr. every four hours, or aspirin in doses of 15 gr. at similar intervals, may be given with or without quinine, and often relieves the pain quickly and effectively. Where, however, there is an unmistakably gouty element colchicum is often required, and may be given thus : ℞. Vin. Colchici, ♏15 ; Sodii Salicyl., gr. 15; Potass. Bicarb., gr. 30; Glycerin., ♏30; Aq. Menth. Pip., ad ℥j; every four hours; but unless it is clear that the case is definitely one of gouty fibrositis aspirin is preferable.

In more chronic cases guaiacum is perhaps the most useful drug and may be administered in doses of 3 gr. of the resin three times a day, alone or combined, as in the case of other forms of chronic rheumatism. Quinine, especially with iodide of potassium and alkalies, is useful, but must be given in full doses and may also be combined with cimicifuga. The following prescription is a useful one: ℞. Potassii Iodid., gr. 5; Potassii Bicarb., gr. 40; Tinct. Cimicifugæ, ♏30; Glycerin., ♏30; Aq. Menth. Pip., ad ℥j. [U.S.P. ℞. Potassii Iodid., gr. 5: Potassii Bicarb., gr. 40; Tinct. Cimicifugæ, ♏15; Glycerin., ♏30; Aq. Menth. Pip., ad. ℥j.]. ℞. Quinin. Sulph., gr. 3 ; Ac. Tartaric, gr. 22 ; Aquæ. ad. ℥ss; *Sig.:* To be mixed with water and drunk while effervescing three or four times a day.

The most useful external applications in the acute forms are the salicylate liniments referred to in the section on Chronic Rheumatism and the aconite belladonna and chloroform liniment. In the chronic stages a great variety of liniments are in common use, and any good rubefacient seems to act well, the "lin. terebinthinæ aceticum" [U.S.P. ℞. Terebinthæ, 44·00; Acid. Acetic. Glacial., 11·00; Lin. Camphoræ, 44·00] is very effective, and the use of capsicum in the form of "chillie paste" has acquired a considerable vogue.

Massage.—This is the most useful of all methods of treatment in the later stages of muscular rheumatism. So long as there is much pain only the lighter manipulations must be used, commencing with light firm stroking movements, always in the direction of the circulation. The stroking may gradually be made firmer and more force used until definite kneading movements can be borne without pain. Wherever nodules can be felt they should receive special attention, being firmly rubbed with a circular movement against the underlying tissues or between the finger and thumb, by which means they will gradually be dispersed. Massage is advantageously preceded by the application of superheated air by means of the apparatus referred to in the preceding section, and in spa practice the use of hot douching with massage is of great value. Vapour baths are often very effective.

Vibratory massage by means of a hard rubber or even a steel ball driven by means of an electric motor, or, where electricity is unobtainable, by mechanical means, is often useful in dealing with deep-seated nodules and indurations.

The use of cataphoresis or ionisation has been described in dealing with chronic rheumatism and need not be further referred to. Of other electrical methods the breeze from a high-frequency or static machine may be mentioned; it will sometimes produce speedy relief in the slighter cases.

What has already been said in dealing with chronic rheumatism in general upon the subject of diet, climate, spa methods, clothing, etc., applies equally to muscular rhematism and need not be repeated here.

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INTOXICATIONS.

ALCOHOLISM.

Acute Alcoholic Poisoning.—There are certain acute but comparatively mild degrees of drunkenness. In such cases the symptoms vary according to the idiosyncrasy of the patient. His higher controlling centres become disordered; he may then become abnormally loquacious or silent, hilarious or morose, happy or quarrelsome. In some cases, the articulation and gait become sufficiently inco-ordinate to attract the attention of lay observers, policemen or others. Such patients, if left to themselves, usually become drowsy, fall asleep, and after a time wake up sober, but with headache, depression and violent nausea. An individual of this milder type of alcoholic poisoning may vomit before falling asleep or even during his sleep; such vomiting is beneficial and should not be checked. In fact, the milder degrees of drunkenness are often usefully treated by an emetic dose of apomorphine ($\frac{1}{10}$ to $\frac{1}{4}$ gr.) hypodermically, a remedy which will produce vomiting followed by sound sleep. The morning headache and nausea which so commonly follow a joyous alcoholic evening are successfully treated by full doses (say 20 gr.) of calcium lactate.

More serious cases are those in which the patient has taken so much alcohol as to be in a state bordering on coma, incapable of being roused except by the most violent stimuli. His temperature is subnormal and his pupils dilated. This is the familiar "dead-drunk" patient, as seen in the casualty department of any hospital. In the treatment of such a case emetics, such as apomorphine, are to be avoided, lest they produce dangerous cardiac depression. The stomach must be emptied, however, and this is best accomplished by means of a soft stomach tube, siphoning out the gastric contents with large quantities of warm water, until the returned fluid is free from alcoholic odour. When the stomach has thus been emptied, it is advisable, before withdrawing the tube, to pour in half a pint of strong hot coffee, together with a saline aperient mixture, such as 2 drachms of magnesium sulphate, with 20 min. of dilute sulphuric acid in an ounce of peppermint water. If there is threatened respiratory or cardiac failure it may be necessary to administer digitalis and strychnine hypodermically and to perform artificial respiration. If the heart and lungs are acting satisfactorily we leave the patient to sleep, keeping him warmly wrapped up until he comes to himself.

Chronic Alcoholism.—Habitual excess in alcohol produces injurious effects upon many organs and tissues. Thus, for example, hepatic cirrhosis and chronic gastric catarrh, with its characteristic morning vomiting, constitute together a vicious circle, or rather a vicious spiral, which may either prove directly fatal or, by lowering the patient's resistance, may render him an easy prey to intermittent maladies, pulmonary, cardiac and others. Renal cirrhosis from chronic alcoholism is fairly frequent. Fatty degeneration of the cardiac muscle is not uncommon. Arteriosclerosis is usually claimed as a common result of alcoholism, but as a matter of clinical experience the percentage of cases presenting high arterial pressure as measured with a manometer, is remarkably small.

Perhaps the most striking physical signs of chronic alcoholism are those which affect the nervous system. Peripheral neuritis, with its familiar drop-foot and drop-wrist, its muscular tenderness, its cutaneous hyperalgesia combined with moderate tactile anæsthesia and its loss of deep reflexes, forms a clinical picture easy of recognition.

But the most serious results produced by chronic alcoholism are in the central nervous system. The highest cerebral functions are markedly affected. The patient's moral and intellectual powers deteriorate, he becomes irritable, excitable, sometimes tremulous; his memory fails, his business and his family suffer, and unless he is rescued by suitable treatment he becomes a physical, social and moral wreck.

Tolerance for alcoholic drinks varies in different individuals within wide limits, so that it is impossible to state a hard and fast rule as to the daily amount of alcohol above which temperance ceases and excess begins. As a useful working maxim, we may say that whenever an otherwise healthy individual feels that casual abstinence from alcohol causes him any physical or mental discomfort, he should stop and carefully consider whether his habitual intake of alcohol is becoming excessive.

The three chief forms of chronic alcoholism with which we meet in practice are dipsomania, pseudo-dipsomania and chronic inebriety. Each of these calls for special treatment, and in the following description I shall base my remarks largely upon the experience of cases treated in the Norwood Sanatorium under the medical superintendence of Dr. Hare. For several years I have been a member of the advisory medical committee of the sanatorium, and from personal observation I can vouch for the accuracy of the Norwood results.

By **Dipsomania** we mean a paroxysmally recurrent overwhelming craving for alcoholic excess, such craving coming on spontaneously without being led up to by intervening chronic inebriety. Dipsomania is a congenital idiosyncrasy, not the result of chronic tippling. Patients of this class have an intervening quiescent period between their attacks varying from a few weeks to several months, during which there is no alcoholic craving whatever. Then comes a premonitory stage lasting several days or even a week, during which the patient's character and disposition change; he becomes sleepless, peculiar in temper, restless, loses his appetite, and finally the desire for alcohol in large quantity becomes overwhelming and he drinks heavily and uncontrollably. The drunken bout may last for a week or more. It then commonly culminates in gastric catarrh, vomiting and prostration, a sort of gastric crisis, and the patient comes to himself, repentant and ashamed, to go on again with another quiescent period culminating in due course in another attack, and so on. In dipsomaniac women the alcoholic craving sometimes immediately precedes the menstrual period by a few days, and may pass off when the flow is established. In true dipsomania, as already explained, the patient does not necessarily suffer from any alcoholic tendencies during the quiescent intervals. I have, in fact, known patients to whom alcohol was actually distasteful. In other words, alcoholism is a symptom of dipsomania, not its immediate cause.

The treatment of true dipsomania varies according to the stage in which the patient comes under our care. If the attack is already in full swing and he is drinking heavily, we can usually cut it short by giving an emetic dose ($\frac{1}{10}$ gr.) of apomorphine hypodermically. This precipitates the gastric crisis and produces vomiting within a few minutes, followed almost at once by sound sleep lasting from three to eight hours. When the patient wakes up he is usually free from his craving; we may then give smaller doses ($\frac{1}{40}$ to $\frac{1}{30}$ gr.) of apomorphine every three or four hours for three or four doses to induce a mild hypnotic effect.

If the dipsomaniac is caught during the premonitory stage of restlessness with commencing craving for alcohol, here again apomorphine is of great value. An emetic dose is not necessary; a small dose ($\frac{1}{40}$ to $\frac{1}{30}$ gr.) which produces merely a suspicion of nausea, followed by several hours' sleep, suffices, and this dose can be repeated if necessary.

Unfortunately, it must be confessed that we have at present no means of preventing the periodic recurrence of the alcoholic craving, even although the patient abstains from alcohol after his aborted attack. We can, however, watch for the next batch of premonitory signs and on each occasion step in again with small doses of apomorphine. In such patients the family physician, who is familiar with the treatment and who possesses the confidence of the patient and his friends, is a true sheet-anchor.

By **Pseudo-dipsomania** we mean paroxysmal alcoholic orgies not occurring spontaneously as in true dipsomania, but induced by the taking of alcohol. The true dipsomaniac can sometimes drink in moderation (during the quiescent period), but the pseudo-dipsomaniac can never do so. He has no spontaneous craving for alcohol, but the smallest amount of alcohol leads to an outburst. The attacks, therefore, occur not periodically but haphazard, depending on accidental taking of alcohol. Here, " ce n'est que le premier pas qui coûte," and once started, the drunken bout goes on for an indefinite period, until it terminates with a gastric crisis or with physical exhaustion. A false periodicity sometimes appears, as when a pseudo-dipsomaniac receives his funds on fixed dates or when there are regularly recurring sources of worry, stress or depression. Thus one Norwood patient had a paroxysm every quarter-day, another at the time of his half-yearly balance, a third at the periodic visits of a particularly tactless relative, and so on. A certain proportion of pseudo-dipsomaniacs are originally continuous drinkers who have made only temporarily successful efforts to become abstainers. Remorse or other moral impressions restrain them for a time, but if they once take a small dose of alcohol the drinking bout speedily bursts forth in full luxuriance.

The treatment of these pseudo-dipsomaniac paroxysms is similar to that above described for true dipsomania during an attack. Alcohol is at once withdrawn and an emetic dose of apomorphine is given, followed by smaller sedative doses.

Both in true dipsomania and still more in paroxysmal pseudo-dipsomania, hypnotic suggestion is often beneficial. For successful treatment of this sort it is essential to have the patient's co-operation; he must be willing to be cured. Hypnotism, of course, can only be applied during an interparoxysmal period. Deep hypnosis should be aimed at, and should be repeated regularly every week for several successive *séances*, and thereafter at longer intervals to confirm the original suggestion. Not only must relief of the alcoholic craving be suggested, but also a distaste for the drug. Total abstinence is the only safe rule for such patients.

Chronic Inebriety differs in many respects from the two preceding varieties of alcoholism. The chronic inebriate almost always begins as a moderate drinker, and in the course of a longer or shorter period he passes on to excess so gradually that he can rarely give even an approximate idea as to when he began to exceed. As a rule, he does not become obviously intoxicated, for by frequent small but ever-increasing doses of alcohol he has succeeded in establishing a high degree of tolerance to alcohol, to which he is apt to refer with pride as to a praiseworthy achievement. This tolerance of alcohol, however, has a counterbalancing intolerance of abstinence, so that without his daily or hourly allowance of alcohol the patient is totally incapable of remaining on his ordinary physical and mental level. In severe cases the chronic inebriate lives in constant terror of being accidentally cut off from an adequate supply of alcohol. The majority of such patients have albuminuria, yet, as already mentioned, permanently high blood-pressure is singularly uncommon. In this class of case the patient is in danger of the two major alcoholic emergencies, delirium tremens and alcoholic epilepsy. Both these complications of chronic inebriety generally follow a sudden diminution or withdrawal of the amount of alcohol to which the patient has become habituated, and, as we shall see, this fact has to be borne in mind in the treatment of chronic inebriety. Many cases of delirium tremens occur in patients who from accident or acute illness, or other cause, *e.g.*, confinement to prison, are suddenly rendered unable to secure their habitual large dose of alcohol.

Delirium Tremens commences with abnormal nervousness and restlessness, insomnia, anorexia, nausea, and perhaps vomiting. After twenty-four to forty-eight hours violent muscular tremors appear, finally accompanied by noisy delirium and by the vivid visual hallucinations, especially of insects and animals, familiar to the lay writer.

Similarly, alcoholic epilepsy is usually a withdrawal symptom in a chronic inebriate from whom the alcohol has been suddenly cut off. The symptoms are those of an ordinary major epileptic fit.

Both delirium tremens and alcoholic epilepsy may be prevented by avoiding sudden withdrawal of alcohol. Supposing the patient has been taking a bottle of whisky daily (equivalent to 25 fluid ounces), it is advisable to cut this down by about 4 or 5 oz. daily. Experience has shown that when this is done delirium tremens and alcoholic epilepsy hardly ever occur; more than this, if premonitory symptoms, such as restlessness, insomnia and tremor have already appeared, they may be aborted in some cases by temporarily raising the dose of alcohol. After a day or so, sleep having reappeared and restlessness being checked, a more gradual withdrawal can then be commenced afresh.

Once delirium tremens is in full swing we have to treat it symptomatically. The first and most urgent indication is to produce sleep. The patient must be kept in a quiet room, carefully watched by skilled nurses or attendants. A preliminary hot bath has an excellent sedative effect, and should be employed whenever available. Failing this, a cold pack is a good substitute, the patient being wrapped in a large sheet wrung out of cold water and then enveloped in several layers of thick blankets. He must be kept in bed and fed with easily assimilated food, such as hot milk or beef-tea and strong soups.

In mild cases sleep may occur without hypnotic drugs, but in more severe cases a hypnotic mixture containing pot. bromid. (30 gr.) with chloral. hydrat. (20 gr.) and tinct. hyoscyami (30 min.) may be required. This mixture is often more efficacious if administered in a small glass of stout. In cases with wild motor excitement, $\frac{1}{100}$ gr. of hyoscine hydrobromide may be given hypodermically, and will usually serve to calm the patient.

Mechanical restraint should be avoided if possible. In most cases a tactful female nurse is able to control the patient, but she should have the assistance of a strong male attendant in case of emergencies. If the patient is violently excited and struggling to get out of bed a convenient way of restraining him is by laying a folded sheet across his waist, between the blankets, and tying it firmly beneath the bed, thereby including both the patient and the bed.

Alcohol should be avoided. If heart failure threatens digitalin ($\frac{1}{100}$ gr.) hypodermically, and ammonium carbonate by the mouth, should be given. A careful daily examination of the chest should be made, lest pneumonia and other complications supervene.

When the patient has attained convalescence he should be placed on a tonic mixture containing nux vomica and, if possible, be sent off for a holiday under the supervision of a firm and tactful companion.

Chronic Excess.—Successful treatment can only be carried out in suitable surroundings. It is essential that the patient shall be removed from his ordinary environment and placed in a nursing home or other special institution, under the continuous observation of a physician and with trained nurses. It should be explained to him that whilst the probable result of his treatment will be to remove his desire for alcohol, and that such desire will remain in abeyance until he takes it again, yet if he once recommences, all his acquired security will disappear. (In true periodic dipsomania, as already explained, the desire is not eradicated, even although the patient remains an abstainer.)

On admission a careful and complete physical examination of the patient is made. Unless there is some contra-indication, a brisk initial purge is administered. The patient is put upon a tonic mixture containing strychnine, atropine and cinchona. The following is the prescription at present employed at Norwood: ℞. Liq. Cinchonæ Conc., ♏24; Liq. Gentian. Co. Conc., ♏8; Sol. Strych. Nit. (gr. 4 ad ℥j), ♏1 ; Sol. Atropin. Sulph. (gr. 1 ad ℥j), ♏1 ; Glycerini, ʒj ; Aquam, ad ℥ ss.

This is given five times daily in water at intervals of three hours. In addition, strychnine nitrate (4 gr. to 1 oz.) and atropine sulphate (1 gr. to 1 oz.) are given hypodermically three times a day, immediately after meals. The dose of strychnine solution begins at 2 min. and increases by 1 min. every other day until the maximum (7 min.) is reached. The dose of atropine solution begins at 1 min. and is increased by 1 min. every other day up to the maximum of 6 min. The following is the routine in an average case:

First Week.—Gradual increase to 5 min. of strychnine solution and 4 min. atropine solution.

Second Week.—Continued increase to a maximum of 7 min. of strychnine solution and 6 min. of atropine solution.

Third Week.—Continuation of maximum doses of 7 min. strychnine solution and 6 min. atropine solution.

Fourth Week.—Reduction of dose to 6 min. of strychnine solution and 5 min. of atropine solution.

Fifth Week.—Further reduction to 5 min. of strychnine solution and 4 min. of atropine solution.

Sixth Week.—Progressive reduction to 2 min. of strychnine solution and 1 min. of atropine solution, this minimal dose being attained at the end of the sixth week.

An important question is as to the withdrawal of alcohol. As already stated, experience has shown that sudden withdrawal of alcohol in heavy drinkers who have acquired a high degree of tolerance is apt to be followed in some cases by insomnia, and even by delirium tremens or by alcoholic epilepsy. For this reason it is found advisable to withdraw the alcohol gradually and regularly. Thus, for example, in a patient who has been consuming a bottle (25 oz.) of whisky a day without obvious intoxication or other symptoms beyond the characteristic aroma of the breath, he is allowed about 19 oz. on the first day, and on successive days 16, 13, 10, 6 and 2 oz., until, on the seventh day, he gets none at all. By judicious "tapering" such as this we lessen the probability of delirium tremens, whilst the patient has practically no discomfort.

Patients who have only been taking a comparatively small quantity of alcohol can be cut off it at once; but if on the first day of abstinence premonitory symptoms appear, such as nervousness, restlessness, insomnia, tremors, anorexia and nausea or vomiting, this is an indication for "tapering" in place of sudden withdrawal. Patients with marked albuminuria should also be "tapered" and not suddenly cut off.

I am in the habit of keeping the patient in bed during the first week at least. After that he is allowed up, and encouraged to go out of doors for gentle exercise under tactful supervision. As the dose of atropin rises the patient's pupils become dilated, and his accommodation may be temporarily impaired. After the second week the patient is allowed to go out freely on parole, returning at regular times for his medicine and injections. In debilitated patients general massage is of great benefit. Ordinary exercise in the open air, short of fatigue, is recommended. Golf is particularly suitable as a pastime during the progress of the treatment. A daily time-table of occupation should be drawn up and its performance should be insisted on. A generous, easily assimilated diet and regular meal-times should be ensured. Sleep must also be carefully attended to.

At the end of a six weeks' course such as above described the patient is generally in excellent physical condition and able to resume his ordinary occupation.

All these measures require tactful but firm supervision on the part of the physician, and can rarely be carried out satisfactorily save in a nursing home or other establishment specially arranged for the purpose or in the household of some medical man who will personally supervise the treatment. Country surroundings are best.

PURVES STEWART.

ARSENICAL POISONING.

In acute arsenical poisoning, symptoms may supervene within one hour: they are for the most part gastro-intestinal. Much depends upon the chemical composition of the compound taken. Two grains of the oxide have caused death. Vomiting is a common symptom and is often intense. The vomited matter may contain bile or blood. There is diarrhœa; the stools, which are watery and show strings or flakes of mucus, are almost choleraic in appearance. The patient complains of severe cramps in the legs. The urine is scanty, the face is cyanosed, and there are cold sweats. Within twenty-four hours the patient may be dead. In subacute poisoning, although death may not take place for a few days, there is similar marked, but less, disturbance of the alimentary canal to which attention has just been drawn, as well as the accompanying muscular cramps, sleeplessness, paralysis and delirium.

Arseniuretted hydrogen, for the most part a product of the chemical laboratory, has caused death by its destructive influence upon the red blood corpuscles. The hæmolysis is followed by jaundice and hæmaturia. The liver and spleen are enlarged. In melting shops, where impure zinc is treated by sulphuric and hydrochloric acids, arsenic fumes are given off. These have caused serious symptoms.

Tolerance of Arsenic.—It has for long been known that the peasantry of Styria and of the Tyrol, in order to become long-winded, eat arsenic and acquire a tolerance to it. Beginning in early adult life (seventeen to eighteen years of age) with a small part of a grain of sulphide of arsenic, they gradually increase the dose until they can take 15 gr. or more. Animals also become immune to arsenic. I have gradually accustomed dogs to arsenic, so that comparatively large doses could be administered without bad effect. On the contrary, there was an improvement in the pelt and the general appearance of the animal. It is difficult to explain the tolerance of the drug. Arsenic tends to accumulate in the bones, the liver and the brain, and can be recovered from those organs after death.

TREATMENT.

In acute poisoning the stomach must be evacuated by means of emetics or by the stomach-pump, care being taken to neutralise the poison as far as possible. The best antidote to arsenic is the hydrated peroxide of iron, since it forms insoluble compounds with arsenious and arsenic acid. It can be readily prepared by adding ammonia to the solution of perchloride or persulphate of iron, it ought to be given in fairly large doses and at short intervals. Any alkali almost may be used to precipitate the persulphate of iron. Calcined magnesia boiled in water is equally efficacious. By triturating 15 grammes of magnesia and 30 of sulphate of iron in 500 grammes of water, there are formed iron peroxide, hydrated magnesia and sulphate of magnesia. This combination possesses the advantage of acting as an aperient. To the triturated iron and magnesia mixture vegetable charcoal is sometimes added with the object of mechanically holding back the arsenious acid. Large doses of the iron and magnesia mixture can be administered with safety, or castor oil may be given with a view of clearing out all material lying in the intestinal canal. Should there be pain, opium may be added.

In chronic arsenical poisoning the symptoms calling for treatment are derangements of the intestinal canal, laryngeal and bronchial catarrh, nerve troubles, and paresis or paralysis of muscles. When the acute stage of poisoning has passed into the chronic, there are usually a rise of temperature with colic and retraction of the abdomen, headache, thirst, vomiting, diarrhœa, paresis of the limbs, tremors and paralysis. As the paralysis is attended by pain, this may be relieved by aspirin and bromide of potassium, by rest in bed, and by the application of tepid lead and opium lotion. If vomiting continues, an effervescing soda, magnesia and bismuth mixture may be given; for coryza bathing the eye with weak boric lotion is of service; and for irritable skin eruptions or ulceration, calamine ointment with or without bismuth or boracic acid may be prescribed. Massage and electricity can always be resorted to where muscular weakness remains after paralysis has disappeared or is disappearing slowly.

THOMAS OLIVER.

COCAINISM.

The treatment of cocainism is very similar to that of morphinism (q. v.). The effects of cocaine show themselves more speedily than do those of morphia, and are even more marked, while the habit of taking the drug is very apt to be followed by mental symptoms of a serious character. The character of the patient changes, he becomes suspicious and often makes false accusations, and hallucinations, impulsiveness and delusions, very often of persecution, develop. The process of withdrawal of the drug is accompanied by less painful symptoms than in the case of the morphiamaniac, and sometimes these may even be entirely absent; but though this is the case the prognosis is often by no means good, for even when the habit seems to have been entirely broken, and that with but little discomfort to the patient, the mental condition may have become so perverted that an imperious obsession to use the drug remains, and results only too often in relapse.

As already stated, these patients frequently are most suspicious. Delusions of persecution may lead them to do acts of violence, and in all cases they must be treated as dangerous persons. When the mental symptoms are marked they not uncommonly necessitate the patient being placed under certificates as a person of unsound mind.

MAURICE CRAIG and E. D. MACNAMARA.

FOOD POISONING.

This may arise from **meat, milk and milk preparations, fish and shell-fish, grain and vegetable food.**

Before commencing the treatment of the case it is important that an opinion should be formed of the type of poisoning which is to be dealt with.

Cases of food poisoning may be classified as follows, and this classification will include the vast majority of cases of food poisoning, and will serve as a general guide to the treatment to be employed in a particular case:

(1) Cases of acute gastric catarrh or acute indigestion.

(2) Cases of ptomaine poisoning or bacterial food poisoning.

(3) Cases of metallic poisoning due to the presence of poisonous metals in tinned foods.

Cases of Acute Gastric Catarrh or Acute Indigestion.—The symptoms in these cases will arise from the eating of a quantity of food which is indigestible, but at the same time wholesome if taken in small quantity. The condition of the patient, as regards liability to indigestion from dietetic indiscretions, the taking of the food upon an empty stomach, and the nature of the food are all important factors for consideration before deciding whether the case comes under this category. For example: the eating of a quantity of sardines or such indigestible food as crab, salmon, lobster, pork, etc., or the eating of a quantity of unripe fruit by children, are all instances of types of food which are likely to set up acute gastric catarrh.

The patient will suffer from nausea and sickness, and there will be present abdominal pain and discomfort. It is not likely that diarrhœa will be present in the early stages. The temperature and pulse will show little alteration from the normal, and there will be no signs of collapse. The patient should be put to bed. If the food has been taken within three hours of being seen by his medical man, a stimulant emetic should be administered, such as a dessert-spoonful of powdered mustard, or 30 gr. of carbonate of ammonia in half a tumblerful of warm water. Vomiting should be promoted by tickling of the pharynx and fauces with the finger or a feather. In suitable cases the administration of emetics may with advantage be substituted by thorough washing out of the stomach: for this purpose a soft rubber stomach-tube should be used, size No. 18, to which is attached a piece of rubber tubing 4 feet long, with a glass funnel at the distal end. The rubber tube is moistened with warm water and a little glycerine applied. It is then carefully passed by the right hand down the pharynx and œsophagus into the stomach, the left forefinger being placed in the mouth of the patient and used as a guide for the tube. When 18 to 20 inches of the tube are passed, and its lower end is in the stomach, warm water is poured into the funnel. On depressing the funnel the contents of the stomach can be syphoned off. Afterwards about 30 oz. of warm water should be added, and the contents again withdrawn. After one or two repetitions of this process the stomach contents will come away clear, and the gastric lavage may be discontinued. The patient should be given an aperient. One fluid ounce of castor oil is a suitable dose for an adult; if there is abdominal pain it is an advantage to add 8 minims of nepenthe or tincture of opium. The castor oil can with advantage be given with a little brandy, the latter being used to moisten the warm glass before pouring in it the oil to be administered. If desirable, calomel (gr. 3), combined with pulv. ipecac. co. [U.S.P. pulv. ipecac. et opii] (gr. 5), may be given in place of the castor oil. For children 1 drachm of castor oil or 3 gr. of grey powder may be given. If the patient is in abdominal pain, local applications to the abdomen, such as hot fomentations, turpentine stupes, linseed-meal poultices with or without mustard, belladonna fomentations, or anti-phlogistine may be employed.

The diet should consist of water, barley-water, or albumin-water, or diluted citrated milk. No solid food should be given until the symptoms have abated. If there is collapse or much abdominal pain, a little brandy should be given.

For continued vomiting a mixture of: ℞ Bismuth. Carbonatis, gr. 20; Sod. Bicarb., gr. 10; Acid. Hydrocyanic. Dil., ♏3; Spt. Chloroformi, ♏ 10; Aq. Menth. Pip., ad ℥j, may be given every three hours, and if there is much pain, nepenthe in doses of 5 minims may be added to the mixture.

The symptoms of acute gastric catarrh from indigestible food usually subside quickly under the above treatment. The cases which give rise to anxiety and special care are usually those occurring in children. It must be remembered that in some cases the symptoms of acute gastric catarrh will be succeeded by a definite gastro-enteritis, necessitating most careful treatment for days.

Cases of Ptomaine Poisoning or Bacterial Food Poisoning.—In these cases the food giving rise to symptoms has been contaminated by the special bacteria which are the cause of ptomaine poisoning. The food will contain not only the pathogenic bacteria, but also a varying amount of toxines (so-called ptomaines) which have been produced by the growth of the bacteria in the contaminated food. Examples of foods which have frequently been associated with ptomaine poisoning are meat, tinned meats, fish, shell-fish, tinned fish, milk, etc., also preparations of any of the above articles, such as soups, potted meats, meat pies, ham, condensed milk, etc. It is important to remember that the great majority of cases of ptomaine poisoning are in reality cases of acute gastro-enteritis arising from a definite bacterial infection, the pathogenic microbes occurring in the contaminated food. The symptoms come on from a few hours to three or four days after taking the poisoned food, and they are of an acute character, there being commonly severe vomiting and diarrhœa with abdominal pain. The temperature is usually raised, and severe cases will show great prostration and collapse with feeble pulse. Skin rashes of the type of erythema, urticaria or purpura are not infrequently present. The stools are often liquid and offensive, mucus and blood being present. These cases require most careful treatment, since the symptoms are often of a dangerous and pernicious character. The patient should be kept in bed and warmth applied by blankets and hot bottles. Emetics and gastric lavage will not be applicable, since the food will probably have been taken several hours before the onset of the symptoms. If the case does not show much collapse an aperient should at once be given, *e.g.*: Castor Oil, ʒj, given in a little brandy, or Calomel, gr. 2; Sodium Bicarbonate, gr. 5. For abdominal pain hot applications to the abdomen should be applied as mentioned above. In cases where there is much fever, an ice-bag is often a valuable application to the abdomen for the relief of pain. In cases where there is much sickness and diarrhœa, it will be necessary to control these symptoms by giving a mixture such as: ℞. Bismuth. Carbonatis, gr. 15; Bismuth. Salicylatis, gr. 15; Acid. Hydrocyan. Dil., ♏3; Spt. Chloroform., ♏10; Sod. Bicarb., gr. 10; Aq. Menth. Pip., ad ʒj, every three hours. To this mixture may be added nepenthe (♏5) if the symptoms are acute enough to call for it.

The diet should consist of liquids, such as water, albumin-water, made with the whites of three eggs to 1 pint of normal saline, the addition of milk sugar (1 oz. to 1 pint) being a great advantage. During the acute symptoms milk is often best avoided. If given peptonised, milk or citrated milk (gr. 2 of sodium citrate to 1 oz. of milk) should be used, and this should be diluted with an equal quantity of water. Brandy is usually a valuable addition to the diet, 1 to 2 drachms being given with each feed, the feeds consisting at first of 3 to 4 oz. of liquid every two hours. Where there is severe diarrhœa or collapse, irrigation of the bowel with warm normal saline is of great value. About 2 pints of warm saline may be gently passed by means of a long soft rubber tube inserted for about 5 inches into the rectum. The injection should be given slowly by means of an irrigator or funnel, and not by a syringe. Usually some of the saline is retained and absorbed.

In cases where the vomiting and diarrhœa are very severe and associated with much abdominal pain, it will be necessary to give a hypodermic injection of a salt of morphia, ¼ gr. for an adult. Great care must be taken in the use of morphia for children. It should be avoided, if possible. If given, $\frac{1}{100}$ gr. is a full dose for a child under one year.

Where the vomiting is not controlled by the bismuth mixture above mentioned, iced water or iced champagne may be tried. Tincture of iodine (in doses of 1 or 2 drops [U.S.P. ½ to 1] in ½ oz. of water given frequently) is sometimes beneficial. When, however, the vomiting still persists, it will be found much the wisest course to wash out the stomach with warm normal saline, to which a little sodium bicarbonate may be added.

Usually the above methods of treatment will suffice, except in the very severe cases. In these it may be necessary to give, for controlling the diarrhœa, a rectal injection of 2 oz. of starch mucilage, containing, in the case of an adult, 15 minims [U.S.P. 9 minims] of tincture of opium.

For the collapse in severe cases subcutaneous injections of warm normal saline should be given in the mammary region. Also oxygen is beneficial. It will be found of great advantage to give oxygen passed in a stream through a wash-bottle containing absolute alcohol, the small amount of alcohol vapour coming over with the oxygen acting as a valuable stimulant.

When the case shows signs of improvement, the diet may be increased, and more citrated or peptonised milk may be given. No solid food should be allowed until the temperature has been normal for at least five days. Before putting the patient on to solid food, thin arrowroot or eggs beaten up in milk or Benger's food may be given.

Where the symptoms of intestinal irritation persist, intestinal antiseptics may be prescribed, such as: Bismuth Salicylate, gr. 15; Salol, gr. 8; Benzo-naphthol, gr. 8; or Cyllin (Intestinal), ♏ 3 (in capsules), every eight hours.

In the treatment of cases of ptomaine poisoning it is very important to remember that the exact ætiology of the case has a definite bearing from the point of view of the public health as well as from a medico-legal view, since epidemics of such cases are not uncommon and frequently legal actions ensue.

It is a wise precaution to have the stools examined by a bacteriologist, and, if possible, the suspected article of food. The blood of the patient should be tested by the agglutination test for the presence of infection by a suspected microbe. By means of bacteriological investigations it is often possible to determine the organism responsible for the illness, and this knowledge will serve as guidance in the treatment of the case. For example, if the illness is set up by the paratyphoid bacillus, or an organism allied to the typhoid bacillus, such as the bacillus enteritidis of Gärtner, it will be a wise precaution to conduct the treatment of the case on lines similar to that of typhoid fever.

It must never be forgotten that sometimes cases of ptomaine poisoning are associated with an actual infection of typhoid fever, and the Widal test should always be applied to a suspicious case.

Cases of poisoning by shell-fish and also by milk are commonly associated by an infection with the typhoid bacillus.

Cases of food poisoning due to sausages are sometimes associated with characteristic nervous symptoms, such as paralysis of the ocular or pharyngeal muscles or loss of power in other muscles of the body. There also are symptoms of profound toxæmia in these cases and the condition is known as Botulismus, being due to the bacillus Botulinus. The treatment is on the lines above indicated.

Cases of Metallic Poisoning due to the Presence of Poisonous Metals in Tinned Foods.—Metallic poisoning from tinned foods is very rare, and is not likely to occur unless the article of food has some liquid in the tin, such as fruit juice or liquefied jelly, or soup. Metallic poisoning is most likely to occur if the liquid in the tin is acid, as in the case of fruit juice. The immediate treatment of the acute symptoms of metallic poisoning will be on the lines indicated under Ptomaine Poisoning. The poison is best eliminated by giving: Magnesii Sulphatis, ʒj; Sodii Sulphatis, ʒj; Aq. Chloroformi, ad ℥j [U.S.P. ℞. Magnesii Sulphatis, ʒj: Sodii Sulphatis, ʒj; Aq. Chloroformi, ℥½; Aquam, ad ℥j], every eight hours. This to be continued for some days after the onset of the symptoms.

Grain Food Poisoning.—This occurs in the case of rye contaminated with the ergot fungus, and gives rise to ergotism.

Lathyrism and pellagra also result from contaminated grain. All of these conditions are associated with symptoms of degeneration of the ascending and descending tracts of the spinal cord. The treatment consists in avoidance of the causal agent, and symptomatic treatment for the symptoms of the nervous disease.

WILLIAM HENRY WILLCOX.

LEAD POISONING.

The treatment of lead poisoning resolves itself into that for such acute symptoms as colic, and for the more chronic such as paralysis, general debility, and the constitutional state consequent upon the effects of lead upon the kidneys, heart, and nervous system.

Colic.—If there is constipation, this should be removed, if possible, by the administration of 1 oz. or more of castor oil, or by warm drinks of sulphate of magnesia with carminatives, and, if necessary, the additional help of olive oil and warm water enemata. A convenient prescription is: Magnesii Sulphatis, ʒvj; Tincturæ Belladonnæ, ʒjss; Tincturæ Cardamomi Co., ʒiv; Tincturæ Zingiberis, ʒiv; Aquam Destillatam, q.s., ad ℥viij [U.S.P. ℞. Magnesii Sulphatis, ʒvj; Tincturæ Belladonnæ, ʒij; Tincturæ Cardamomi Co., ʒiv; Tincturæ Zingiberis, ʒij; Aquam Destillatam ad ℥viij]. Sig.: A tablespoonful in warm water every two or three hours until the bowels have been moved.

Olive oil in one or two tablespoonful doses in warm water may be administered by the mouth, and repeated if it is retained. One of the difficulties in the treatment of lead colic by aperients is the accompanying vomiting. If vomiting persists, it should be met by the application of a mustard and linseed poultice to the abdomen, and by the administration of: ℞. Sodii Bicarbonatis, ʒij; Liq. Bismuthi et Ammon. Citratis, ℥ss; Spiritus Ammoniæ Aromatici, ʒij; Tincturæ Zingiberis, ʒij; Spiritus Chloroformi, ♏40; Aquam Destillatam, ad ℥viij. M. ft. mist. Sig. The Mixture No. I.: ℞. Acidi Tartarici, ʒjss; Aquam Destillatam, ad ℥iv. M. ft. Mist. Sig. The Mixture No. II. [U.S.P. ℞. Sodii Bicarbonatis, ʒij; Bismuthi et Ammon. Citratis, gr. 24: Spiritus Ammoniæ Aromatici, ʒij: Tincturæ Zingiberis, ʒj; Spiritus Chloroformi, ʒss; Aquam Destillatam, ad ℥viij. M. ft. mist. Sig. The Mixture No. I.: ℞. Acidi Tartarici, ʒjss; Aquam Destillatam, ad ℥iv. M. ft. mist. Sig. The Mixture No. II.]. One tablespoonful of No. II. to be added to two tablespoonfuls of No. I. and drunk during effervescence four times a day.

Notwithstanding the administration of aperients, and their action upon the bowels, the pain is not always immediately relieved; this shows that constipation is neither necessarily the cause nor the accompaniment of lead colic. So severe and exhausting at times is the pain that a hypodermic injection of morphia (gr. ⅛ to ⅓) may be called for. Failing relief, the injection of morphia may be repeated, or the patient immersed in a warm bath. Mono-sulphite of soda (in ½-gr. doses, administered every two hours, or in 2 or 3 gr. doses thrice daily, combined with carminatives, such as cardamoms or ginger) often gives rapid relief both in acute colic and in that form of abdominal pain which lingers for days after the attack of acute pain has passed away. Dr. G. A. Stephens has found permanganate of calcium (in ¼-gr. doses, administered in pill or in paraffin capsule) helpful not only in lead colic, but for muscular paresis as well. In some of my cases it has given satisfactory results.

It is not desirable to give potassium iodide on the occasion of a first visit to a patient who is suffering from lead colic. Combined with magnesium sulphate, it is a good remedy, but its administration requires to be watched, for, as Melsens showed, potassium iodide sets free lead which has been lying stored up in the tissues, and thereby aggravates symptoms. In cases of latent plumbism I have known it light up symptoms of acute poisoning which, in two patients, ended in death. I have seen it induce albuminuria in plumbism and cause delirium. When carefully watched, potassium iodide is, in cases where there is mild paralysis and where cachexia and pallor are not too pronounced, a valuable drug, especially if it is given with small doses of magnesium sulphate and tinct. nucis vom.

For paralysis of the extensors of wrists and fingers relief may be obtained by placing the hands and forearm in a splint and resting them in a sling for a few hours daily, but at as early a date as possible massage and electricity should be employed. It is of little consequence what form of electricity is made use of so long as a response is obtained and care is taken not to employ too strong a current, or to prolong the application so as to induce fatigue. The value of electrical treatment is not to be measured by the amount of visible muscular contraction which takes place, for there are invisible nutritive and vaso-motor effects which are of just as great value. Induction-coil currents exercise a stimulating influence upon living tissue by producing a decidedly tonic effect upon the muscles; they favour nutrition and a return of the contractile power. The paralysed muscles of wrist and fingers can be treated by means of an electric bath, followed by massage. The paralysed arms are placed in a tepid bath and a faradic current reaching to 40 milliampères is gradually applied for twenty minutes. The electric bath does more than stimulate enfeebled muscles to contract; it assists in the elimination of lead from the body. The administration of liq. strychninæ at this stage of the illness is helpful.

Where **headache** is persistent and is of gouty origin, citrate of lithia (in 5-gr. doses) may be given, or the following: ℞. Potassii Bromidi, ʒiij; Magnes. Sulphatis, ʒiv; Tinct. Zingiberis, ʒiv; Tinct. Cardam. Co., ʒvj; Aquam Destillatam, ad ℥viij. M. ft. mist. [U.S.P. ℞. Potassii Bromid., ʒiij; Magnes. Sulphatis, ʒiv; Tinct. Zingiberis, ʒij; Tinct. Cardam. Co., ʒvj; Aquam Destillatam, ad ℥viij]. Sig.: A tablespoonful in water thrice daily between meals.

Should either of the above fail to relieve headache, and there are signs of increased cerebral pressure, lumbar puncture may be resorted to. A long needle is introduced into the spinal canal between the second and third lumbar vertebræ and clear watery fluid removed. This often comes away under high pressure.

For **Saturnine Encephalopathy**, or that form of the malady in which there are convulsions and coma attended or not by the presence of albumin in the urine, inhalation of nitrite of amyl may be resorted to. For the peculiar anæmia or **saturnine cachexia**, attended by frequent headache, loss of appetite, general decline of mental and bodily activities, small doses of iron and magnesium sulphate may be given with, if there are signs of irritability of the nervous system, a few grains of potassium bromide. Bone-marrow tabloids and hæmaboloids are also useful. Should symptoms of uræmia arise, attended by high arterial tension, ¼ or ½ gr. doses of nitrite of sodium, combined with small quantities of magnesium sulphate, are likely to afford relief.

PREVENTION OF INDUSTRIAL PLUMBISM.

There is the risk of plumbism in all occupations in which lead is used. Insistence upon personal cleanliness on the part of the workers, abstinence from food when at work, never eating until the hands have been thoroughly washed, the wearing of overalls when at work, and of respirators when employed in dusty processes, rigid temperance in the use of alcohol, a warm bath at least once a week and free ventilation of the workroom will do much to prevent or diminish this risk. All lead workers should take aperients regularly. Magnesium sulphate is supposed by some physicians to convert any lead that may be present in the stomach and bowels into the more insoluble sulphate, but the benefit obtained from saline aperients depends less upon this hypothetical probability than upon the stimulus which is given to elimination generally. In obscure cases of plumbism the drinking water should be examined, and if it is found to contain lead, due in all likelihood to the water having been carried through an excessive length of lead piping, either iron pipes should be substituted for those made of lead, and the water allowed to run for a short time before using it, or the water in the reservoir should be treated by such hardening agents as magnesium limestone or a silicate.

THOMAS OLIVER.

MORPHINISM.

The treatment of morphia-mania fundamentally consists in the rapid or slow withdrawal of the particular preparation of opium affected by the patient. As any withdrawal entails, at least, symptoms of extreme discomfort, and, at times, symptoms of the most grave character, it is necessarily accompanied by remedial measures directed towards the amelioration of these symptoms. Preliminary to the commencement of the reduction of the drug it is of the greatest importance that the patient's general health should be carefully attended to and that he should, for so long as may appear necessary, be placed in the best hygienic conditions. Regulated rest of body and mind, alternating with moderate exercise, should be prescribed. So far as possible time should be passed in the open-air and the diet should be suitable to the probably defective condition of the alimentary tract of the patient. Alcohol, coffee and tea, articles of diet frequently abused by this class of patient, should be reduced in quantity, taken only at certain definite times, and, if necessary, suppressed. Whenever possible the patient's general health should be improved and his weight raised before the withdrawal of the drug is commenced.

Sudden suppression of the drug has at times been advocated. Such a procedure is very apt to be followed by serious collapse, and should only be tried where the patient's physical condition is very good, where his age is less than forty, and where it is of importance that the cure should be effected in a short space of time.

The rapid method of withdrawal, as opposed to the sudden method, involves a reduction of the dose of the drug from day to day, so that by the tenth or fourteenth day the last dose is given. If on the first day of treatment the dose to which the patient has been accustomed be given, it may be reduced by one-tenth or one-fourteenth on each successive day, so that on the tenth or fourteenth day one-tenth or one-fourteenth of the original dose is given and thereafter the drug is totally suppressed. In cases where there is much cachexia, renal disease, arterio-sclerosis or cardiac disease, the withdrawal of the drug is usually made to last over a much longer time, for instance, six to eight weeks, and in such cases the daily reduction of dose is far smaller than in the rapid method.

Treatment can rarely be satisfactorily carried out at home. The patient has opportunities of procuring and secreting the drug, which, in a properly conducted establishment adapted for such cases, are reduced to a minimum. At home, too, there can be no such assurance of an absence of worrying intercourse and correspondence as there can be when the visits of friends and relations and the reception of letters are rigorously interdicted. So also is the patient safe from a response to his appeals *ad misericordiam*; appeals which produce no effect upon the trained minds of the physician and the nurse, but which addressed to relatives are only too likely to lead to a neutralisation or abandonment of treatment.

The patient should, then, be placed in a suitable home, in the charge of skilled nurses and under the supervision of the physician. He must be treated as suspect, his clothes and trunks should be examined, and every letter and parcel should be strictly inspected, for it must be remembered that he may use every possible means, whether by bribery of his attendants or otherwise, to procure the drug.

As the reduction of the drug is commenced, so will various more or less unpleasant or serious symptoms show themselves. In almost all cases, whether accompanied by serious symptoms or not, motor and psychic agitation will manifest itself, accompanied by general and indefinable feelings of distress. There may also be hypersecretion of various glandular organs, and running at the eyes and nose is common. There may be gastralgia accompanied by vomiting and diarrhœa, general hyperæsthesia and neuralgic pains. Of more serious import are the symptoms indicative of collapse, such as coldness of the surface, a feeling of faintness, cold sweating, cyanosis, lowered temperature and a feeble, slow and irregular pulse. To combat these exceedingly trying and at times most grave symptoms, various drugs and other therapeutic measures have from time to time been proposed.

The first measure of prime importance is that the patient should be put to bed and his temperature, his pulse and respiration rates, the occasions of defæcation and the amount of urine passed, as carefully recorded as though he were suffering from some acute infective process. Among drugs recently vaunted *hyoscine* holds a prominent place. A dose of $\frac{1}{100}$ gr. of the hydrobromate is given hypodermically, and this is followed at hourly intervals by doses of $\frac{1}{200}$ gr. After the first few doses the patient becomes drowsy, but with further doses a mild delirium is produced, usually accompanied by thirst, not disagreeable hallucinations and other symptoms of an intoxication analogous to that produced by belladonna and the allied drugs. When this condition has been induced hyoscine is continued in the smaller doses for another twenty-four or thirty-six hours. On stopping the administration of hyoscine, the morbid craving is abated and in favourable cases abolished. At this stage it becomes desirable to eliminate the hyoscine from the system, and this is best done by producing profuse diaphoresis. Pilocarpin nitrate may be administered in doses ranging from $\frac{1}{8}$ to $\frac{1}{6}$ gr. If during the administration of the hyoscine it appears to be necessary to stimulate the heart strychnine may be given. During the treatment the diet should be liberal and of an easily digestible nature. Food should be administered frequently in small amounts. Beef-tea and meat juices will be found helpful in counteracting the craving for morphia during its withdrawal. If there is a tendency to sickness the food should be peptonised. Alcohol should be avoided except in states of collapse or in those cases where there is a tendency to heart failure from the first. Hot baths will be found most useful in relieving the restlessness and can be given night and morning or when occasion arises. Other treatment consists in continued rest combined with fresh air, massage and a liberal dietary. Among other drugs used to combat restlessness and similar symptoms may be mentioned the bromides, trional, veronal, medinal, amylene hydrate and paraldehyde. A drug which is still upon its trial, but which appears to be of value in cases of confirmed opium smoking, is *Combretum Sundiacum.* The leaves and twigs of the plant are dried in the sun and roasted after being finely divided. Eight to eleven oz. are boiled in 4 gallons of water, and of this concoction the dose is 1½ oz. to be taken three times a day. During the administration of the drug the amount of opium or morphia is gradually reduced. The drug is highly thought of by natives of China and has been tried with success by European observers. In any case, it is hoped by the administration of this class of drugs to produce quietude of mind and body and a diminution in the hypersensitiveness which follows upon the reduction of the morphia. At times cocaine and chloral have been advocated. Both are undesirable, inasmuch as they may be subsequently abused by the patient, and one habit may simply be replaced by another as pernicious or even worse. Chloral has the further disadvantage of depressing the heart, an organ upon which, in these cases, a serious strain is being placed. Symptoms less distressing to the patient himself than those already enumerated, but of even graver import to the physician, are those indicating heart failure or a tendency thereto. The various cardiac stimulants must now be relied upon : Spirit of ether and the aromatic spirits of ammonia, alcohol, ammonium carbonate, strychnine, digitalis, caffeine, and sparteine sulphate. Some authorities recommend that the latter drug should be given from the first so that it gradually replaces the morphia. The initial dose is ⅓ gr., and this is increased to ⅔ gr. given four to six times a day. If the blood pressure is found to be high nitro-glycerine and erythrol tetranitrate in ¼ to ⅙ gr. doses may be given. Last of all, if life appears to be imperilled, the physician must have recourse to morphia itself, which, under these circumstances, should be given in the smallest doses possible and without the patient knowing the nature of the drug he is receiving. Whereas morphia injected hypodermically is excreted into the stomach and diminishes the secretion of the gastric juice, so, when it is withdrawn, a much-increased activity of the glands takes place and the symptoms of hyperchlorhydria develop. These are best combated by washing out the stomach, using some mineral water, the best perhaps being Vichy, or a weak solution of bicarbonate of sodium.

If the gastric symptoms are severe the patient may be placed for a few days on a milk diet; hot fomentations may be applied to the epigastrium and bismuth and soda administered.

The methods of *psychotherapy*, either with hypnosis or without, should in all cases be resorted to. The consequences of the habit, with the accompanying inevitable physical and mental deterioration, should be explained to the patient. He should be told that cure has often been obtained in other cases and that he may look forward to a resumption of that self-control which is amongst the most enviable possessions of a man. When the consent of a patient to the commencement of treatment has been obtained a very considerable step in the right direction has been taken, and it remains for the physician to keep the patient hopeful and to encourage a resolution which from the first is only too likely to be faint-hearted. Suggestion under hypnosis has been vaunted from time to time and without doubt has had its successes. It is not, however, in this affection a panacea. Suggestion under hypnosis is best directed towards the re-establishment of the patient's health, the promotion of sleep and the strengthening of his courage. If these objects can be achieved the satisfaction of the craving for the drug becomes less urgent as the days go on, and is eventually displaced by indifference or even by dislike.

When there is good reason to suppose that the habit has been broken, for the physician must not be misled by too rapid and easy a cure, during which it is only too probable that the patient has had access to the drug, it becomes imperative to regard the patient as one convalescent from some serious malady and by all possible methods to re-establish the health. For drugs, quinine, iron and arsenic may be given and the patient should live in the open-air, gradually accustoming himself to those activities of life which are at once pleasant and healthy.

So far we have only dealt with the patient who is desirous of being treated, but there are many persons who from loss of will power, failure to appreciate the serious condition of their health and other reasons, neither seek nor desire treatment. If persuasion has failed it may become necessary for the medical attendant to decide whether some further action should not be taken, and, as in all drug cases, it is advisable to divide the responsibility by consultation with a medical colleague. Although there may be great moral deterioration and some mental enfeeblement, the unsoundness is not always definite enough to render certification an easy matter. Nevertheless, in his own interests, he should be placed under care, if this is possible, as it is probably his only chance of regaining health.

MAURICE CRAIG and E. D. MACNAMARA.

PELLAGRA.

SINCE most authorities agree in considering that pellagra is an intoxication, the first need is to put the patient into the best possible condition for assimilating his food. It is convenient to make a description of the treatment correspond with the stages of the disease.

Early cases can be recognised by an expert, but as the earliest symptoms are usually confined to the skin, the patient does not often consult a physician. These early symptoms can be cured by giving a liberal mixed diet, from which maize (*Zea mays*) and its products are excluded, and to which fresh vegetables and fruit, such as oranges or lemons, are added. Other important essentials are rest, fresh air, with protection from the sun's rays, cleanliness, clean linen and general hygiene. An early case, cured in this simple way, will relapse if a return is made to the original food and insanitary life.

The erythema and dermatitis seen on exposed parts of the body may require an initial washing with turpentine to remove the co-existing dirt, after which zinc ointment or salt baths will aid the lesions to disappear. Burning or smarting pain of the skin can be soothed by lint soaked in equal parts of linseed oil and lime-water. Baths at any temperature agreeable to the patient will be found useful for the cutaneous irritation and also for the insomnia which is often present.

The patient should be weighed regularly to see how far the treatment is successful and to decide if cod-liver oil must be added to the dietary.

Attention must be directed to any co-existing diseases, such as alcoholism, malaria, syphilis, ankylostomiasis, bilharziasis, and any other entozoa or favus of the scalp.

Persons suffering from advanced disease are, sooner or later, obliged to seek medical assistance because their dyspepsia, loss of appetite, and gradually increasing mental depression prevent their working and earning money.

Soreness of the tongue, due to denuded epithelium, may require treatment to prevent inflammation spreading towards the parotid glands, and it is important to insure that the teeth and gums are kept as clean as possible. For this purpose peroxide of hydrogen or a saturated solution of boracic acid or a solution of argyrol (10 gr. to 1 oz.) may be enough. The dyspeptic symptoms, thirst, taste of salt, and epigastric tenderness, will yield to milk diet and to the discontinuance of the maize-made bread or mush (polenta) which has been irritating the stomach. Though constipation is an early symptom, it is diarrhœa which, in very advanced cases, taxes every effort of food and drugs. Sour milk I have tried without great success. Cow's milk suits the patient better than buffalo's, and in any case the milk should be boiled and given with lime-water. An initial dose of castor oil removes any irritating substances, and can be followed by salicylate of bismuth (15 gr. every four hours), with or without tannic acid (5 gr.) or tannigen (10 gr.). Opium should be avoided because it is liable to aggravate the nervous symptoms. If the diarrhœa becomes dysenteric in character, large enemata, consisting of 2 or 3 pints of saline solution (8 per 1,000), or of starch and water, will be useful. Tonics by the mouth are always essential unless their use is temporarily postponed by diarrhœa. Any form of iron is indicated by the accompanying anæmia, ferratin (8 gr., t.d.) being the most easy to assimilate. If the eggs of *Ankylostomum duodenale* are found in the fæces, a weekly dose of eucalyptus oil, ♏30, chloroform, ♏45, and castor oil ʒx, must be repeated until the worms are all expelled. Salicylate of quinine (5 gr., t.d.) is a good tonic, and also acts as an antiseptic in the alimentary canal. But as advanced pellagra is a cerebro-spinal disease, it is necessary to give some form of strychnia or arsenic when there are no co-existing diseases which are calling for treatment.

Strychnine should be given three times daily in $\frac{1}{60}$ gr. pills, or in ♏5 doses of the liq. strychninæ [U.S.P. strychnin. hydrochlor., gr. $\frac{1}{22}$] in 1 oz. of water. Arsenic can be given similarly in pills ($\frac{1}{60}$ gr. of arsenious acid), or in ♏5 doses of Fowler's solution, remembering that arsenic must be taken after meals, and should not be continued for more than three weeks without an interval.

Atoxyl has been used in Roumania since 1907 by Babes and Vasiliu. They reported that a rapid cure of acute cases sometimes took place after two or three weekly hypodermic injections of 1½ gr. for adults and of ¾ to 1 gr. for children. In chronic cases they reported that great improvement took place in a fortnight after ten daily injections of 1½ gr. of atoxyl. In 1909 they further reported that they had cured fourteen cases by employing once a week an injection of 8 gr. of atoxyl, arsenious acid ($\frac{1}{15}$ gr.) as a pill, and smearing arsenic ointment on the skin; seven of the cases were cured in ten days, while seven others were cured in less than a month. This treatment has since been tried, at my instigation, in Egypt and in some of the southern United States without marked benefit to chronic cases, though early cases have been improved by it. Soamin has been found equally unsatisfactory, and now that several cases of optic atrophy have occurred after the use of atoxyl and soamin in syphilis and other protozoal diseases, one can no longer recommend these preparations of arsenic. Arsacetin has not yet been found to possess so many poisonous drawbacks, and four doctors have praised its use in Pavia (Italy), the dose being 1½ gr. hypodermically on alternate days.

Fresh bone-marrow I have found a distinct help to some bad cases, producing gain in weight and additional sleep. Thyroid extract is also of value in chronic cases, or 2 gr. of desiccated thyroids three times a day, continued during several weeks.

Since 1889 attempts have been made by Babes and others to find an anti-toxic serum, and during the last two years twenty cases in America have been treated by direct *blood transfusion.* Cole and Winthrop report that four of these cases were in a hopeless condition at the time of operation and died without any obvious improvement, but in the remaining instances there followed either cure or marked amelioration. Two of these successful cases were transfused from cured pellagrous patients, while five others received blood from relatives who had never had pellagra, but who had been exposed to the same risks of the disease as the patients themselves; it is possible that these donors had developed a certain amount of immunity and contained anti-toxic bodies in their blood. These American cases were transfused by the cannula method of Crile or by Carrel's suture method, which permits blood to pass from the artery of the healthy person into the vein of the patient without any danger of its clotting. The cases now mentioned raise hopes that the near future may supply us with a serum treatment for pellagra, already begun by Antonini and Marianni and others in Italy.

No sane pellagrous patient requires to be isolated, though one or two writers have suggested that the disease may be directly communicable.

The popular treatment by setons or by the actual cautery to the neighbourhood of the dorsal vertebræ or elsewhere, is quite unnecessary, because pain and tenderness along the spine will disappear if the patient is given a month's rest.

Lunatics.—After two or more years of pellagra the patient's state is liable to pass gradually into a confirmed melancholia, too often ending in amentia or dementia, while a few become maniacal.

Asylum treatment is then necessary to prevent suicide or homicide, for the patient suffers from delusions which are insane renderings of his subjective symptoms, and he often imagines that he is being poisoned by the person who prepares his food.

Drug treatment is now of little avail, though arsacetin, or possibly Ehrlich's salvarsan and saline or serum injections may be tried.

For a century and a-half diseased maize has been held to be the chief cause of pellagra, but since 1905 Sambon has advanced the theory that it may be a protozoal disease associated with a biting insect, such as a *Simulium*.

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PHOSPHORUS POISONING.

In acute phosphorus poisoning one of the earliest symptoms is pain referred to the pit of the stomach. This is usually accompanied by retching and vomiting of bloody-looking material. During the act of swallowing there may have been experienced a disagreeable burning sensation in the œsophagus; but as a rule it is not until three or four hours have elapsed that stomach symptoms develop. If the patient is seen early, and the stomach is washed out with permanganate of potassium, no other symptom may develop. If the stomach-pump is available, copper sulphate may thus be introduced. This forms with any phosphorus which may be present the harmless black phosphide of copper. Milk and all fatty food must be avoided, for fat dissolves phosphorus. This remark does not apply to oil of turpentine, which is a good antidote. Immediately after washing out the stomach 40 minims of turpentine in water may be given, and repeated if necessary.

When absorption of phosphorus from the stomach has occurred, the damage is already done; for the liver becomes the seat of a subacute inflammatory process, attended by disintegration and fatty degeneration of the hepatic cells, and followed on about the third day by jaundice. Phosphorus has been occasionally resorted to by pregnant females to rid the uterus of its contents; but success in this direction has often been followed by the death of the mother.

The treatment of chronic phosphorus poisoning must be regulated by symptoms as they appear.

THOMAS OLIVER.

POISONS AND ANTIDOTES.

Cases of chemical poisoning are of common occurrence, and it is of vital importance that they should be treated promptly and correctly.

The following classification will be of value in considering the treatment of cases of poisoning:

(1) Cases of Corrosive Poisoning.
(2) Cases of Irritant Poisoning.
(3) Cases due to Narcotic and other Poisons.
(4) Cases of Poisoning by Gaseous Poisons.

It is a wise precaution in all cases of suspected poisoning to preserve carefully any vomit or urine for analysis by a competent analyst.

CORROSIVE POISONING.

Under this heading will be considered: (*a*) Poisoning by the mineral acids; (*b*) poisoning by the caustic alkalies; (*c*) poisoning by ammonia; (*d*) poisoning by phenol; (*e*) poisoning by oxalic acid.

Poisoning by the Mineral Acids.—Hydrochloric acid or spirit of salt, sulphuric acid or oil of vitriol, nitric acid or aqua fortis, are the common mineral acids, and cases of poisoning by these are of frequent occurrence.

There will be the usual symptoms of acute gastric irritation. The mucous membrane of the mouth will probably show signs of corrosive action, such as patches of superficial necrosis, blackening, sloughing, etc. The vomit will most likely contain blood or altered blood, and it will probably be strongly acid. It will turn blue litmus red and give the tests for free mineral acids, *e.g.*, Congo red paper will be turned blue, a solution of di-methyl-amido-azo-benzene in alcohol will be turned cherry red, or a few drops of the vomit, if mixed with a solution of phloro-glucin and vanillin in alcohol and evaporated to dryness on the water bath, will give a cherry-red colour (Günzberg's test).

The immediate treatment consists in giving a harmless alkali by the mouth to neutralise the acid. An ounce of magnesium oxide suspended in water should be given, or if this is not available, sodium bicarbonate, ½ oz. in water, or even washing soda, two teaspoonfuls dissolved in ½ pint of water. Chalk or whiting suspended in water may also be given freely. The stomach must not be washed out for fear of perforation. In the case of the volatile mineral acid, nitric acid, the effect of the acid on the lungs may be neutralised by the inhalation of the vapour from hot water containing ½ oz. of carbonate of ammonia.

The after-treatment of cases of mineral-acid poisoning consists in avoiding the giving of food by the mouth for the first few days. Nutrient enemata and normal saline should be given per rectum. Collapse should be treated by warmth, oxygen, the injection subcutaneously or into a vein of normal saline; strychnine and brandy may be given hypodermically. For the relief of pain a salt of morphia (gr. ¼ hypodermically) should be prescribed.

Poisoning by the Caustic Alkalies.—These are caustic soda or soda lye, caustic potash or potash lye, carbonate of potash or salts of tartar.

There will probably be marks of corrosive action on the mouth and throat. The vomit will most likely contain blood or altered blood, and be definitely alkaline, turning red litmus paper blue.

The immediate treatment consists in the giving by the mouth of harmless vegetable acids well diluted: thus vinegar, 6 oz.; lemon juice, 4 oz.; citric acid, ½ oz.; or tartaric acid, ½ oz., may be given well diluted with water, and repeated if necessary.

The stomach should not be washed out for fear of perforation. *The after-treatment* of the case is similar to that of corrosive-acid poisoning, *vide supra.*

Poisoning by Ammonia.—Ammonia, or spirits of hartshorn, or Scrubb's cloudy ammonia are common preparations. The smell of the poison is characteristic, and the vomit and breath of the patient will probably turn red litmus paper blue. *The immediate treatment* consists in the giving by the mouth of harmless vegetable acids, as in the case of caustic alkali poisoning.

Ammonia frequently acts on the lungs, causing bronchitis, broncho-pneumonia and other inflammatory conditions, therefore it is always advisable to attempt the early neutralisation of the inhaled ammonia by the inhalation of vapour from very hot water containing 1 oz. of glacial acetic acid, or ½ oz. of benzoic acid.

The after-treatment is symptomatic.

Poisoning by Phenol.—Phenol, or carbolic acid, or disinfectant fluid is a common cause of poisoning. The mucous membrane of the mouth and pharynx usually shows white sloughs. The smell of the poison is characteristic. The vomit may contain blood and the filtered vomit will give a copious precipitate with bromine water. *The immediate treatment* consists in giving 2 pints of lime-water by the mouth, or, better, ½ pint of saccharated water. In any case the stomach should be washed out with warm water, a soft tube being passed. Collapse should be treated on the lines indicated above.

Oxalic Acid.—Poisoning by the acid or the acid potassium salt, known as salts of lemon or salts of sorrel, is very common.

The immediate treatment consists in giving as soon as possible about ½ oz. of chalk or whiting made into a cream with lime-water, saccharated lime-water, or plain water. In this way the oxalic acid is converted into insoluble and harmless calcium oxalate. It is better not to wash out the stomach if the above antidotes are available, since they are effectual in rendering the unabsorbed poison harmless.

Oxalic-acid poisoning is usually followed by great collapse, and the patient should be carefully treated for this by the application of warmth, the administration of warm saline and brandy per rectum, strychnine (gr. $\frac{1}{20}$) should be given hypodermically, and, if necessary, subcutaneous or intra-venous injections of normal saline may be employed.

In severe cases oxygen, or, better still, oxygen bubbled through absolute alcohol, should be administered.

Nutrient feeding is advisable for the first twenty-four hours, after which milk may be given by the mouth. In some cases nervous symptoms arise, such as convulsions, anæsthesia, paræsthesia, etc. These symptoms are best treated by the antidotes above mentioned, combined with any special symptomatic treatment for the nervous symptoms which arise.

IRRITANT POISONING.

In all cases of irritant poisoning, where the poison has been taken within three or four hours of seeing the patient, it is advisable to wash out the stomach thoroughly with warm water and afterwards to apply the special antidote and the subsequent appropriate treatment. The following is a list of the common irritant poisons, with their respective treatment :

Acute Phosphorus Poisoning. — After washing out the stomach, permanganate of potash solution (1 in 2,000) or the liquor potassii permanganatis B.P. [U.S.P. 1 in 100], diluted about twenty times, should be introduced freely, and the stomach washed out with this liquid. Instead of this a solution of sanitas (1 per cent.) or hydrogen peroxide (1 per cent.) may be used.

Sometimes a solution of 5 gr. of copper sulphate dissolved in water is of value.

An aperient such as calomel (gr. 3) and magnesium sulphate (2 drachms) in water should be given. A salt of morphia (gr. ⅓) should be given hypodermically for the relief of pain. Demulcent drinks, such as linseed-tea, milk, arrowroot-water, etc., may be given by the mouth. The patient must be kept carefully nursed in bed for several days after taking phosphorus, and a guarded prognosis should be given, since dangerous symptoms, such as vomiting, jaundice, coma, sometimes occur after a period of intermission of symptoms for some days.

Acute Arsenical Poisoning.—The stomach should be washed out or an emetic of mustard and water given. As an antidote freshly precipitated ferric hydrate should be given (½ oz. of tincture or solution of perchloride of iron [U.S.P. 3 fluid drachms of tincture of ferric chloride or 1 fluid drachm of solution of ferric chloride] in half a tumblerful of water, to which has been added a solution of washing soda, until the liquid is distinctly alkaline to red litmus paper). A tablespoonful of oxide of magnesia suspended in water may be given in the place of the ferric hydrate. The subsequent treatment consists in the giving of a salt of morphia hypodermically (gr. ¼) for the relief of pain and purging. The treatment of collapse consists of stimulants and warmth, and if necessary the subcutaneous injection of warm normal saline.

In cases of suspected arsenical poisoning the vomit and urine should always be carefully preserved for analysis.

Acute Antimony Poisoning.—This should be treated similarly to acute arsenical poisoning, the only difference being that the antidote used should be tannic acid (1 drachm) dissolved in warm water. If this is not available, a strong infusion of tea, which has been allowed to infuse for a few minutes, may be given.

Poisoning by butter or chloride of antimony should be treated on the same lines as hydrochloric-acid poisoning, since this preparation of antimony contains an excess of free hydrochloric acid.

Acute Poisoning by Salts of Copper, Tin, Zinc, Lead or Barium.—In these cases the stomach should be washed out and a suitable antidote administered. In the case of copper and tin, white of egg and water should be given freely. In the case of zinc, sodium carbonate (washing soda), 2 drachms dissolved in water, should be given. In the case of lead and barium, 1 oz. of sodium sulphate dissolved in water should be given.

The after-treatment of the above cases of poisoning consists in the treatment of symptoms of pain, collapse, etc., should they arise, and in the elimination of the poison by the bowel by the administration of saline aperients.

Mercurial Poisoning.—Cases of acute mercurial poisoning are of common occurrence, owing to the ease with which tablets of the various salts of mercury used as disinfectants may be purchased.

The immediate treatment consists in the administration of white of egg in order to convert the mercurial salt into an insoluble albuminate. The stomach should be well washed out and a further quantity of white of egg administered. Afterwards symptoms must be treated as they arise. Acute mercurial poisoning is always very serious. In a large number of cases acute suppression of urine occurs, and the usual treatment for this condition must be applied, such as local applications to the loins, hot-air baths, etc. If the kidneys still fail to excrete, the wisest course will be to operate, and a free incision should be made into one kidney. If necessary, after an interval of one or two days the other kidney should be similarly treated.

Acute ulcerative colitis is a dangerous and common late complication of acute mercurial poisoning. The treatment of this condition is that which is described under Acute Ulcerative Colitis.

POISONING BY NARCOTICS AND OTHER POISONS.

Hydrocyanic Acid Poisoning.—Hydrocyanic or prussic acid and potassium cyanide or other cyanides are common causes of poisoning.

If possible, the stomach should be immediately washed out, and if available a mixture may be given as an antidote of 2 drachms of tincture or solution of perchloride of iron [U.S.P. 1½ fluid drachms of tincture of ferric chloride or 30 minims of solution of ferric chloride], with 30 gr. of sulphate of iron and 3 drachms of washing soda. The above should be given in half a tumblerful of water.

Failure of respiration must be prevented if possible by the administration of ammonia and smelling salts to the nostrils, artificial respiration, and, if necessary, faradisation of the phrenic nerves and diaphragm. Hypodermic injections of spirits of ether and of atropine sulphate (gr. $\frac{1}{50}$) should be given. Sodium thiosulphate in 10 per cent. solution given hypodermically in repeated doses of 20 minims has been recommended as an antidote. Collapse must be counteracted by stimulant treatment.

Chloral Hydrate Poisoning.—The stomach should be washed out immediately, first with water and then with weak permanganate of potash solution. Some hot, strong coffee should be administered, and liquor strychninæ should be given in doses of 4 minims [U.S.P.

strychninæ bydrochlor., gr. $\frac{1}{28}$] hypodermically, and repeated if necessary. Ammonia or smelling salts should be applied to the nostrils, and artificial respiration resorted to if necessary. Inhalation of oxygen or, better, oxygen passed through a wash-bottle of absolute alcohol will be advisable. Collapse must be treated by stimulants and warmth.

Chloroform Poisoning.—If taken by the mouth the stomach must be well washed out. Poisoning by either liquid chloroform or its vapour should be treated by artificial respiration if the breathing fails, and if necessary faradisation of the phrenic nerves. Liquor strychninæ (♏4) should be given hypodermically, also liquor atrop. sulph. (♏2) [U.S.P. atropin. sulph., gr. $\frac{1}{55}$].

Inhalations of amyl nitrite are often helpful. If there is cyanosis a free venesection should be performed, and warm saline injected into a vein. For heart failure an injection of pituitary extract is of value, and external massage of the heart may be employed.

Poisoning by Sulphonal, Trional, Tetronal or Veronal.—In these cases the stomach should be thoroughly washed out. Enemata should be given to promote the action of the bowels. Hot, strong coffee should be administered freely, and injections of liquor strychninæ (♏3) [U.S.P. strychninæ hydrochlor., gr. $\frac{1}{36}$] with liquor atrop. sulph. (♏1) [U.S.P. atropin. sulph., gr. $\frac{1}{110}$] should be given hypodermically, and repeated if necessary. Artificial respiration must be resorted to when necessary, and oxygen, or oxygen combined with alcohol vapour, may be given.

Opium and Morphine Poisoning.—The stomach should be washed out thoroughly with water, and afterwards with a weak solution of potassium permanganate (1 in 2,000), or the liquor potassii permanganatis (B.P.) diluted twenty times. The washing out with permanganate solution should be continued until the washings are coloured red. After emptying the stomach, some hot, strong coffee should be given. Liquor atropin. sulph. (♏2) [U.S.P. atropin. sulph., gr. $\frac{1}{55}$] should be given hypodermically and repeated in an hour. Injections of spirit of ether (♏20) may be given hypodermically. Failure of respiration must be treated by administration of ammonia or smelling salts to the nostrils, and, if necessary, artificial respiration and faradisation of the phrenic nerves must be resorted to. After three hours it is advisable to repeat the washing out of the stomach with potassium permanganate in order to neutralise any morphia which has been excreted by the stomach after absorption. If the patient recovers from the immediate symptoms of poisoning, it is advisable to keep him in the recumbent position for a few days, and to give cardiac stimulants, since sometimes fatal syncope occurs after the acute symptoms of poisoning have subsided.

Poisoning by Belladonna, Henbane, Stramonium, Atropine, Hyoscyamine or Hyoscine (Scopolamine).—The stomach should be washed out with water, and afterwards with permanganate of potash, as described under Opium Poisoning. Afterwards hot, strong coffee should be given. Pilocarpine nitrate (gr. $\frac{1}{2}$) should be injected hypodermically, and repeated until the skin becomes moist. If there is excitement, a hypodermic injection of a salt of morphine (gr. $\frac{1}{2}$) should be given. Collapse must be prevented by warmth and oxygen containing alcohol vapour. After the acute symptoms have subsided, rest and cardiac stimulants must be continued for a few days, since syncopal attacks are not uncommon in the late stages of this condition.

Cocaine Poisoning.—The stomach must be washed out with water, and afterwards with potassium permanganate solution as in the case of Morphine Poisoning. Collapse with cardiac failure is very likely to supervene, and the patient must be given warm saline by the bowel. Liquor strychninæ (♏5) [U.S.P. strychninæ hydrochlor., gr. $\frac{1}{22}$] with digitalin (gr. $\frac{1}{100}$) should be given, and repeated every hour if necessary. Oxygen passed through absolute alcohol is advisable. Failure of respiration must be treated by ammonia or smelling salts to the nostrils, and artificial respiration, and faradisation of the phrenics if necessary.

In some cases convulsions occur, and for these chloroform inhalations may be given.

Aconite and Aconitine.—The stomach must be washed out with water, and afterwards with potassium permanganate as in the case of Morphine Poisoning. Digitalin (gr. $\frac{1}{100}$), liquor strychninæ (♏3) [U.S.P. strychninæ hydrochlor., gr. $\frac{1}{36}$], should be given every half-hour if necessary. Warm saline and brandy by the bowel, oxygen with alcohol vapour, and, if necessary, artificial respiration should be employed. Cardiac failure must be guarded against for some days after the taking of the poison.

Poisoning by Cantharides, Turpentine, Potassium Chlorate.—These are renal irritants, and there will be great risk of suppression of urine. The stomach must be washed out and emetics given if necessary. Warmth, stimulants and demulcent drinks by the mouth should be administered freely. Brandy may be of service. For renal irritation hot applications to the loins, cupping, or leeches over the loins should be used. If the kidneys fail to secrete, probably the wisest course will be to operate and make a free incision into one kidney, repeating the treatment on the other kidney in two or three days if necessary.

Acute Ergot Poisoning.—The stomach should be washed out and pulv. jalapæ co. (ʒj) given by the mouth. Liquor strychninæ (♏2) [U.S.P. strychninæ hydrochlor., gr. $\frac{1}{55}$] with liquor trinitrini (♏1) [U.S.P. spiritus glycerylis nitratis] should be given every half-hour. Amyl nitrite inhalations, stimulants, warmth and oxygen with alcohol vapour are advisable.

Pilocarpine and Jaborandi Poisoning.—The stomach should be washed out and liquor. atrop. sulph. (♏2) [U.S.P. atropin. sulph., gr. $\frac{1}{55}$] given every hour until the sweating ceases. Warmth and stimulants and oxygen through alcohol may be prescribed.

Calabar Bean and Physostigmine or Eserine Poisoning.—The stomach should be washed out and liquor atrop. sulph. (♏2) given and repeated until the pupil dilates. Strychnine may be given hypodermically, warmth and brandy by the mouth, and if the respiration fails special treatment should be employed as under Morphine Poisoning.

Digitalis Poisoning.—The stomach should be washed out and hot coffee and brandy given. Liquor trinitrini (♏1) should be given every half-hour. Warmth and stimulant treatment, with absolute rest, are essential.

Poisoning by Veratrine, or by White or Green Hellebore.—The stomach should be washed out and hot coffee and brandy given. Absolute rest and artificial respiration are necessary. Oxygen through alcohol may be necessary. If there is excessive diarrhœa, morphia should be given hypodermically.

The Vegetable Irritants, Savin, Yew, Laburnum, Helleborus Niger, Colchicum or Colchicine.—The stomach should be washed out and warmth and stimulants prescribed. For excessive diarrhœa, morphia should be given hypodermically. Oxygen and artificial respiration may be necessary.

Benzene Compounds, e.g., Aniline, Benzene, Nitrobenzene, Acetanilide (antifebrin), Phenacetin, Antipyrin, Pyridine, etc.—In poisoning by the above the stomach should be washed out. External warmth and stimulant treatment are necessary. Artificial respiration should be employed. Irrigation of the bowel with warm saline is advisable, and collapse should be treated by injections of normal saline subcutaneously or intravenously. Oxygen or oxygen with alcohol vapour will be beneficial.

Tobacco or Nicotine Poisoning. *Acute Poisoning.*—Where the poison has been taken by the mouth, this condition should be treated by washing out the stomach, giving stimulants, warmth and employing artificial respiration and oxygen through alcohol if necessary. Liquor strychninæ (♏2) with digitalin (gr. $\frac{1}{100}$) should be given, and repeated every hour if necessary. Hot, strong coffee should be given by the mouth.

Chronic Tobacco Poisoning results from excessive smoking or snuff-taking, or the inhalation of the tobacco-charged air of factories. Dyspepsia, anæmia, palpitation, defects of vision, tremors, and a tendency to faintness and dizziness are the chief symptoms. There is usually contraction of the field of vision, and central scotoma for red and green.

Treatment consists in the entire removal of the causal agent. Rest, stimulants, and digitalin (gr. $\frac{1}{100}$ hypodermically) three times daily are necessary. In some cases liquor atrop. sulph. (♏1 t.d.s.) will be of value.

GASEOUS POISONS.

Carbon Monoxide Poisoning.—This occurs from coal gas, water gas, or exposure to the suffocating fumes from fires, smoky grates, stoves, or lamps; also from the fumes from geysers.

The diagnosis may be at once made by the clinical symptoms of drowsiness, collapse and coma, and the cherry-red colour of the face and mucous membranes. The examination of the blood will make the diagnosis certain, since the presence of carbon monoxide hæmoglobin may be readily detected by the spectroscope, and the solution of blood in water has a characteristic cherry-red colour quite different from that of normal blood.

The treatment consists in giving oxygen freely, and employing artificial respiration if necessary. Strychnine and digitalin should be given hypodermically, also brandy by the mouth, and warm saline either subcutaneously or by the bowel may be given. For heart failure pituitary extract may be given hypodermically if necessary.

Carbon Dioxide Poisoning, or Carbonic Acid Poisoning.—This occurs in coal mines from choke-damp or after-damp. Cellars of houses, wells, brewers' vats, lime-kilns, etc., frequently contain large quantities of carbonic acid gas. The gas is produced in various combustion processes, and also it occurs in air which has been rendered impure by respiration as in excessive overcrowding.

The treatment consists in fresh air, rest, oxygen, artificial respiration if necessary, and the employment of warmth and stimulants when required.

Sulphuretted Hydrogen Poisoning.—This occurs from contamination of the air with sewer gas, and from the gases evolved when iron slag becomes moistened with water. The gas is frequently produced in various chemical processes.

The treatment consists in giving the patient plenty of fresh air. Oxygen and artificial respiration may be employed, and external warmth and stimulant treatment must be used. Rest in bed for a few days after exposure to the poison will be desirable, and the anæmia caused by the poisoning should be treated by the administration of iron and arsenic and special diet.

Phosphoretted Hydrogen and Arseniuretted Hydrogen Poisoning.—These gases occur occasionally in the air as impurities, and they are excessively poisonous and dangerous. Thus phosphoretted hydrogen occurs in commercial acetylene gas, and arseniuretted hydrogen is produced when acids containing arsenic act on various metals. Also the gases evolved by ferro-silicon, especially if it is moist, contain appreciable quantities of these two deadly gaseous poisons.

The symptoms of poisoning by these gases are very insidious. Sickness, drowsiness, slight jaundice and coma quickly supervene; there is frequently nephritis. The urine contains blood, and is often suppressed.

The treatment consists in rest, stimulants, warmth, the administration of warm saline either per rectum or subcutaneously or into a vein. Oxygen is to be given freely, and special treatment should be employed to counteract the irritant effects of the poisons on the kidneys (*see* Cantharides Poisoning).

WILLIAM HENRY WILLCOX.

SUNSTROKE.

Preventive Treatment.—(1) Most prevalent in (*a*) great heat and hot winds; (*b*) damp oppressive heat and no wind: therefore, under such conditions, care.

(2) Avoid overcrowding in barracks and railway trains, and maintain free ventilation in all human abodes. The site of the house, or camp, should be on high, dry and airy locality—removed from muggy valley, swamp or jungle.

(3) Regulate exercise, and note how exercise merges into fatigue, and that whilst the former is good, the latter strongly predisposes to heat stroke.

(4) Regular occupation-work is good, but worry is bad. When occupation leads to exposure, one should start in the early morning, having partaken of a light and easily digested meal, avoiding the empty as well as the over-distended stomach. If with bodies of men on the march, the march should be in open order, and halts should be regulated according to the capacity of the weaker individuals and at specified intervals. A proper supply of water for drinking should be at hand. Weak, cold tea makes a most excellent beverage. Weed out the sickly before starting.

(5) The clothing should be suitable—nothing to interfere with the cervical circulation or movements—free play allowed to the shoulders and chest. The belly to be kept warm. The colour of the clothing grey, and shape of coat like a Norfolk jacket. The head should have a covering to protect properly the temples (commonest fault) and back of head and neck. An air chamber is essential. There should be a lining of red or orange colour material. Any succulent large leaf over the skull within the hat gives ease. It will be advisable to use glasses of neutral tint to protect the eyes from glare and over-strain. There are varieties of spine-pads used. If the clothing be thin khaki, then a quilted cotton-pad covering the spine and back of shoulders, fastened outside coat and detachable, must be worn. Inside of shirt a light orange-coloured or red silk vest gives great relief and protection.

(6) The diet and habits in the dangerous season should be suitable, and the newcomer must live cautiously under extreme climatic conditions that predispose to and cause sunstroke. He should adopt as much as possible the ways of the "acclimatised." These are

the outcome of what was found suitable to the climate, and lend themselves to practical hygiene—sparing consumption of flesh-meat, strict temperance and avoidance of spirits and beer, a simple diet of white meat, vegetables, pulses and fruits. Work during the cool of the day and rest during its heat, bathing frequently.

(7) Careful attention to the general health should be observed, and attacks of "fever," "liver," "indigestion," and "constipation" have care given to them and not be treated with neglect. The debilitated at the commencement of the hot season should be sent to cooler parts.

(8) In the dangerous times of the year symptoms such as apprehension of impending evil, restlessness, insomnia, headaches, dizziness, feeling of oppression, præcordial anxiety, nausea, dry, hot skin with frequent micturition and fainting tendency, may be forerunners of the graver condition, and the sufferer should be placed under treatment at once to fend off the threatened attack. Such a patient requires immediate removal, if possible, out of the dangerous area.

Should the patient be found unconscious after exposure to heat, do not confound heat stroke with hæmorrhagic apoplexy, alcoholic intoxication, narcotic poisoning, or all of these combined, or with a bad case of pernicious malarial fever, or the hyperpyretic form of an eruptive fever, or the onset of cerebro-spinal meningitis. In some malarial cases where the doubt was as to sunstroke, I have known the happiest results follow the hypodermic injection of 30 gr. of quinine hydrochloride. Had these been treated as simple cases of bad sunstroke, a fatal result would probably have followed the routine treatment.

HEAT EXHAUSTION—HEAT SHOCK.

Syncope from heat, due to direct rays of the sun or heated atmosphere. The patient may be conscious or semi-conscious.

(1) Remove to shade.

(2) Open clothing, freeing neck and chest; place in supine position, head low.

(3) Fan freely to give fresh air.

(4) Cold affusion to face and upper part of chest; flick with wet towel.

(5) Administer cold tea or cold coffee. Ammonia or whisky and cold soda-water may be required.

(6) If the temperature be below normal and there be much depression, give sal volatile, hot tea, ammonia inhalation, ether hypodermically, mustard, or brandy to præcordium. If respiration weak assist by artificial means, and continue till breathing improves

and consciousness is fully established. A *warm* bath may at times be required. Do not move patient till the pulse can be felt.

(7) Place in ambulance; keep up the fanning as necessary. See that the feet and calves of legs are warm, and do not hand over patient till circulation is restored.

(8) He should have quiet and perfect rest for some days and there should be close attention to body functions. As soon as possible he should be sent to the hills or to sea, with avoidance of undue fatigue and exposure, and no return to duty should be considered till the hot season is over.

HEAT STROKE.

(1) Get into shade at once; the cardinal rule is to reduce the temperature (106° to 110°) as soon as possible.

(2) Strip stark and place supine.

(3) Rub with blocks of ice; two to four assistants here will be necessary. Get ready the wet pack sheets from water with floating ice-blocks. Head, shaved, should rest on ice-block at nape of neck. Keep the ice and cold pack going till the temperature falls to 100° (take temperature in rectum).

(4) All the time see that ventilation is free.

(5) Throw 5 gr. calomel on back of tongue; repeat if required.

(6) Enema of iced water; free bowel purge.

(7) Artificial respiration if tendency to difficulty of breathing. Keep it up and do not give in though patient appear moribund.

(8) If right heart strained with prominent jugulars and stertor, then venesection from right external jugular I consider is indicated.

(9) When the temperature has come down, remove to bed; cover lightly, keep ice-bags to or near head; cool the pillows by dry cold.

(10) Fan gently.

(11) Keep warmth to the feet.

(12) The use of heart stimulants (digitalis, strychnia, ammonia) may be necessary.

(13) If there are convulsive seizures, give chloroform carefully and use turpentine enemata.

(14) If restless, potassium bromide or antipyrine may be used. Quinine hypodermically is beneficial, and will be specially so and life-saving if there is a malarial taint, as often happens.

(15) Keep a constant and careful watch against any return of hyperpyrexia.

(16) Light and nourishing food in small quantities at regular times is indicated. Nutrient enemata may be requisite.

Sequelæ.—Bear in mind that all forms of sunstroke impair the power of resisting heat, and also weaken the tolerance of alcohol; therefore change of climate is most desirable, and total abstinence from all forms of alcohol an axiom.

Whilst the after-effects of heat exhaustion may be light and transient, yet, should the patient have passed into a state of thermic fever, there may follow on it great and possibly permanent impairment of nerve function, shown by headache, giddiness, insomnia, loss of memory, diminished power of concentrating attention, easily induced mental and physical fatigue. These symptoms may last for months or years and only yield to prolonged residence in temperate climes.

In some patients, of unstable mental organisation, emotional insanity may ensue, and such may show irritability of temper, excitability, altered habits, loss of self-control, and eventually moral decadence.

With such awful possibilities in the future, great care should be evinced in the after-medical and hygienic treatment of even mild cases. Absolute rest, mental and physical, and then open-air life in a bracing locality will be essential. The food must be plain, simple and nourishing, and spirits and beer be positively banned.

The use of drugs, such as potassium bromide and iodide, may be indicated. Counter-irritation, by blisters or Paquelin's cautery, to the head and neck gives relief. Free action of the bowels, skin and kidneys should be maintained. Some of the worst cases will require care as laid down in the treatment for mental disability in its various forms.

It will be understood that long leave after sunstroke is indispensable, and there should be no return to duty in the tropics for at least a year after all symptoms have subsided. Subjects of bad sunstroke will never be safe except in a cool climate, and their return to the tropics should be prohibited.

HAVELOCK CHARLES.

GENERAL INJURIES.

BURNS AND SCALDS.

Of a hundred cases of burns recorded by Erichsen, seventy-three died before the eighth day, and forty-two of these in the first twenty-four hours. It will be seen from this that shock and collapse are the most potent causes of death which have to be guarded against in the treatment of burns. Should the patient escape these immediate dangers, he may yet succumb to the effects of suppuration, and the complications such as pleurisy, pneumonia, nephritis, etc., which are dependent upon it. At a later date exhaustion from prolonged discharge from granulating surfaces may be fatal, and, short of this, the disfigurements and deformities due to the contraction of scars have, as far as possible, to be prevented. The treatment of burns will be considered, therefore, under the following headings :

(1) **Immediate Treatment.**— The patient is immediately placed in a well-warmed room away from possible draughts, and the charred clothes are cut off, all dragging being avoided. He is then wrapped in blankets, and hot-water bottles are placed near him. If the shock is very marked, a saline injection is given by the rectum (1 or 2 pints at a temperature of 105° F., containing 1 oz. of brandy to 1 pint, is a suitable quantity for an adult). Brandy may be given by the mouth, or if necessary a hypodermic injection of strychnine (gr. $\frac{1}{100}$ to $\frac{1}{20}$). If the pain is severe opium may be administered, and is often useful in diminishing the shock. caused by the necessary dressing. The effects of the drug must, however, be carefully watched, and it should be given only with the greatest caution to children. The cleansing and covering of the burnt areas is now proceeded with, and in the case of an extensive burn it is best to do this by instalments, so that a part only of the affected region is exposed at one time. Less shock is thus occasioned.

(2) **The Local Treatment of the Burnt Areas.**—From the point of view of local treatment, burns may be classified under three headings :

(a) There is superficial scorching of the skin, giving rise to an erythematous inflammation. The burnt areas should be dusted over with a mixture of zinc oxide and boracic powder, and covered with a thin layer of wool, kept in position by bandages. These dressings should be retained for a few days, by which time the inflammatory reaction will have subsided, although some desquamation may follow.

(b) In addition to the congestion of the skin, vesicles of greater or lesser extent form, due to the accumulation of fluid between the cuticle and the true skin. The skin should be carefully disinfected by washing with weak antiseptic lotion: carbolic acid (1 in 60) or biniodide of mercury (1 in 4,000). The vesicles are then snipped at the most dependent part sufficiently to allow of the escape of the contained fluid. The loose cuticle should not be cut away, since healing will proceed more satisfactorily beneath it than beneath any artificial covering. Lint soaked in a saturated solution of picric acid in water is then applied, and over this a layer of sterilised wool is bandaged. This dressing may be left in position for several days, in the absence of a raised temperature or other indications of the beginning of septic processes. Should such complications ensue, care must be taken to see that no pus remains locked up in the bullæ, and the whole of the burnt areas are washed daily or twice daily with boracic lotion, or, if feasible, immersed in a bath of the same. Lint soaked in boracic lotion is now applied, covered by a layer of oiled silk and wool and bandaged on. If necessary the same dressing may be applied hot as a fomentation, at a temperature of 90° to 100° F. After subsidence of the infection it is best to use one of the oily preparations described in the next section.

(c) In this degree some part or the whole of the true skin is destroyed, together, perhaps, with charring of the subcutaneous tissues, muscles, or even of the bone. This class includes the third, fourth, fifth and sixth degrees of Dupuytren. The essential characteristic is that there is actual necrosis of some mass of tissue. This necrotic mass is very difficult to keep free from putrefactive processes. A more or less extensive process of ulceration is needed for its separation, infective processes with resulting absorption of toxic products are prone to occur, and even when this danger has been surmounted and all sloughs have come away, we are left with a granulating surface, sometimes of huge extent, the treatment of which is always tedious and difficult. Adherent shreds of clothing are removed by soaking with boracic lotion, rolled-up pieces of skin and charred fragments of tissue are cut away, blisters are snipped in the most dependent part, and the burnt surface is carefully cleaned with the lotion. In the case of extensive burns, when shock is marked, the utmost expedition must be used in carrying out these measures—while neglect means certain sepsis, prolonged exposure means death. A dressing is now applied of sterilised lint or butter muslin, smeared with eucalyptus vaseline. Over this are placed layers of sterilised wool, and the whole is bandaged on. Other oily preparations in common use are boracic ointment, zinc ointment and carron oil.

Some surgeons prefer wet antiseptic dressings to the oily applications when extensive sloughing is expected. The writer considers that if this plan be adopted, lint soaked in boracic lotion is the only safe application. Absorption from the large damaged areas is so rapid that the danger of poisoning from carbolic acid or mercurial lotions is sufficiently great, especially in children, to outweigh any possible advantages. The wet lint should be covered with oiled silk and a layer of sterilised wool bandaged on over this.

Whichever of these dressings is applied, it will have to be changed daily or even twice daily. It is practically never possible to leave a dressing undisturbed for several days in a burn of the degree now being considered. At subsequent dressings the lint is soaked off by the use of boracic lotion or by immersing the part in a bath. An anæsthetic may be needed for the earlier changes. Septic complications are met by wet dressings or fomentations, or by placing the affected part in a bath. This last method of treatment of severe burns has been extensively practised, the burnt part being placed in a bath of boracic lotion (10 drachms to 1 gallon) until separation of the sloughs. The lotion is kept at a temperature of 100° F., and is frequently changed by running in fresh supplies, whilst the used lotion is syphoned off by an indiarubber tube. This method is easily employed, and is strongly recommended when the upper extremity or the foot is burnt. But for other parts immersion of the whole body may be necessary. In the case of children this can be done only when unremitting care and attention from skilled nurses are available.

(3) Treatment of the Resulting Granulating Surfaces.—The lines of treatment indicated above are continued until all sloughs have separated and granulation of the burnt parts is established. The granulating areas are best treated by being covered with a layer of green protective, which is perforated by a number of small holes to prevent the retention of the discharge. Over this layers of sterile gauze are placed and the dressing bandaged in position. The dressing is removed daily, and peels off without tearing the granulations and without causing bleeding. The wound is

washed over with boracic lotion and the dressing re-applied as before. If the area under treatment be extensive, skin-grafting by the method of Thiersch should be employed at the earliest possible moment; that is to say, as soon as there is a healthy granulating surface to work upon. When the granulations are exuberant and œdematous, stimulating lotions such as lotio rubra (℞ Zinci Sulphatis, gr. 2; Tincturæ Lavandulæ Co., ♏10; Aquam, ad ℥j) may be employed, and occasionally touching with caustic may be necessary. Some surgeons employ the various ointments already described for the treatment of granulating surfaces, but the results are not so good as with the method advised.

During the process of healing the utmost endeavours are to be made to prevent the crippling deformities too often seen after the healing of a burn. Thus, if the axillary region be burnt, the arm must be kept well away from the side. Healing, it is true, will thereby be delayed, but skin-grafting will render it possible. Massage of the scar when healing is complete, combined with judicious movement of adduction, will further aid in the preservation of the function of the arm. In the same way in burns affecting the bend of the elbow the limb during the course of treatment must be kept in a straight splint, and the sedulous employment of movements and massage must be insisted upon to preserve the power of extension at the elbow-joint. Similar measures are to be taken when burns of other regions threaten to affect the ultimate use of the part.

(4) General Treatment.—During the separation of the sloughs and the healing of the granulating surfaces which result, severe calls are made upon the strength and vitality of the patient. Stimulants are usually necessary; nux vomica, iron, quinine and brandy should be administered as required. The diet whilst light should be as liberal as possible. Morphia may be necessary but should be used with caution, and attention must be paid to the evacuations.

(5) Treatment of Contractions following Burns.—In the majority of cases the surgeon will find that the prevention of the occurrence of contractions by the measures just described is an easier matter than their remedy when once they have occurred. In cases where the limbs are affected an apparatus should be applied which by elastic traction or rack-and-pinion movement keeps up constant though slight traction upon the contracted part. This apparatus must be worn by night as well as by day. The scar is massaged and passive movements are employed. If these means fail, or if the case is one of old standing, then some form of operation is called for. Without going into details, it may be said that these operations may be grouped under three headings: (a) Complete division or excision of tight bands and subsequent skin-grafting; (b) plastic operations involving the transplantation of skin; (c) excision of part of the bone with a view to shortening the limb.

MAYNARD SMITH.

CONTUSIONS AND HÆMATOMA.

The chief effect of a contusion is to cause hæmorrhage into the areolar tissue. The pain, swelling, discoloration and the degree of the subsequent impairment of function depend upon the amount of blood extravasated and the rapidity and completeness with which absorption takes place. The two guiding principles in treating a contusion are, therefore, firstly, to limit the amount of hæmorrhage; and, secondly, to favour the rapid and complete absorption of blood. These will be considered separately.

(1) **Measures Directed towards Limiting the Amount of Hæmorrhage.**—Rest is necessary. Cold should be applied to the part, either in the form of ice or as spirit lotion: (℞ Spiritus Vini Methylati, ʒj; Liquoris Ammonii Acetatis, ʒj; Aquam, ad ʒj.) Pressure by means of a firm roller bandage is employed at the same time.

Under certain circumstances this treatment must be modified. In the first place, where the amount of extravasation is great, and the skin is thus entirely lifted away from the underlying tissues, the application of cold might endanger its vitality, and so it is better to wrap the part in wool and apply a firm bandage over this. Secondly, when the rapidity and position of the extravasation points to the fact that a vessel of size has been injured, it may be necessary to make an incision, turn out clot, ligature the vessel, close the wound and apply firm pressure.

(2) **Measures to Ensure Complete and Rapid Absorption.**—When the acute symptoms have passed and hæmorrhage has ceased, massage judiciously employed is an excellent method of promoting absorption. Firm pressure is also applied, and use of the affected part is only gradually resumed. When in spite of these measures a collection of blood shows little inclination to disappear, it should be removed by aspiration. The skin having been carefully purified, a large-sized needle of an aspirator or exploring syringe is thrust into the cavity, which is then emptied as far as possible. The puncture is sealed with collodion, and firm pressure by pads and strapping or bandage is applied.

When effused blood has failed to become absorbed, certain changes take place resulting in the formation of a hæmatoma.

This is a cyst-like collection of serum or dark treacly fluid, with a wall of deposited fibrin or even, in old-standing cases, of fibrous tissue. A hæmatoma should be treated as follows: (1) Aspiration followed by firm pressure and rest (*see* above); (2) if this fails, it is best in the case of small, thick-walled hæmatomata to dissect them out entire; (3) when the position of the hæmatoma contra-indicates the last measure, an incision is made into the tumour, the fluid and clot is removed, and a drainage tube inserted for a few days; pads should be incorporated in the dressings in such a manner as to bring the walls of the cavity together.

MAYNARD SMITH.

ELECTRICAL INJURIES AND BURNS.

When a person receives a severe electric shock there is frequently emitted a cry. It is this circumstance which attracts the attention of a fellow-workman and directs him to the spot, where he finds the apparent lifeless body of his comrade with pale or slightly cyanosed face, the heart no longer beating, pupils dilated and mucus probably oozing from the mouth. The hand may still be grasping the live metal, or, if the contact has been suddenly broken, the body may have been thrown some distance from the seat of the accident. The first thing to do is to break the contact by cutting the wire, care being taken to protect the hands by dry clothing. An axe with a wooden handle will serve for this purpose. So long as the body is in contact with the live metal the greatest care must be exercised, and especially so if the clothes are damp. The jacket, for example, should only be grasped if it is dry. Indiarubber gloves are the best protectives, if they are obtainable; but as every moment is of importance, no time must be lost by the rescuer, who should thickly wrap round his hands dry rags before attempting to pull away the apparently lifeless body from the live metal. Having succeeded, and having placed the body on its back, *artificial respiration* should be at once resorted to and maintained for a considerable time. Kneeling behind the head of the victim, the operator should grasp the elbows and draw them well together over the head, so as to bring them together above it, and after holding them there a few seconds, should carry the arms down and on to the chest, firmly compressing the thoracic walls so as to displace the air in the lungs. The movements should imitate as far as possible the natural movements of respiration and be about sixteen to the minute. In a dog killed by an electric current, whose heart had ceased beating for more than two minutes, and whose respiration had stopped, I succeeded by means of artificial respiration in restoring the animal to life again. Artificial respiration, in all cases of suspended animation after electric shock, should be immediately commenced, and persevered with for an hour or even longer. Stimulants should not be given, although on the arrival of medical assistance caffein, ether or camphorated oil may be injected hypodermically. Upon artificial respiration must rest the hope of restoring life, provided the victim is seen immediately after the accident.

An electrical current, instead of killing immediately, may simply render a person unconscious and cause him to be the subject of epileptiform convulsions. Should the epileptiform seizures continue after the patient has regained consciousness, fairly large doses of a bromide salt may be given, always, of course, watching the effect. Restlessness of the nervous system must be combated by keeping the patient quiet and in bed in a room somewhat darkened. Should there be signs of fear on the part of the patient, he should be reassured and told that the danger is over. If with apprehensiveness there are signs of collapse, small doses of bromide with caffein should be administered.

For weeks or months after apparent recovery from electrical shock a patient may complain of loss of sensation in places, with or without loss of muscular power, also of contraction of the field of vision, symptoms suggestive of traumatic neurasthenia. On the other hand, the symptoms may point to an alteration of structure. Massage, passive movements and the application of electricity may do good. The relation of electrical injuries to the Workmen's Compensation Act must be borne in mind, also the difficulty of stating how long after apparent recovery neurosal symptoms may continue.

Exposure to Strong Electric Light may be followed by erythema of the skin, similar to that produced by the intense rays of the sun. Eye and other troubles may be caused by too close proximity to electric sparks. The skin, eyebrows and eyelashes may be burnt. The conjunctiva may become hyperæmic, and a few days after be the seat of an abundant muco-purulent secretion. There may be an accompanying iritis and a degree of choroidoretinitis. As the structural changes do not clear up quickly, vision remains defective for a considerable time, and headache of a painfully neuralgic character persists. The nearer the eye was to the electric spark the worse are the effects. Treatment of these eye injuries is difficult. Eye lotions have practically no effect upon the conjunctivitis. Antipyrine and quinine relieve the neuralgic headaches with or without the addition of bromide.

For **burns** caused by contact with electrical conductors soothing applications are required. As there is frequently considerable destruction of tissue, sloughing is apt to follow. Olive or linseed oil and alkali dressings give as much relief as any, but as the bones are often injured as well, these may decay and dead portions be thrown off. Electrical burns heal slowly. In order to close a wound skin-grafting may be required. The slow healing of the wound is probably the result of some peculiar effect produced upon the cells of the part, or it may be due to destruction of nerve fibrils.

THOMAS OLIVER.

WOUNDS.

This article is confined to the consideration of the treatment of accidental wounds. For the treatment of operation wounds reference should be made to the article on Surgical Technique.

Local Treatment.—(1) Arrest of Hæmorrhage.—This is the first and most urgent indication in the treatment of a wound. When there is profuse hæmorrhage from an extremity a tourniquet may be applied as a temporary measure. In hæmorrhage from the neck or head, or from other parts where the application of a tourniquet is impracticable, digital compression of the main arterial trunk is performed. These measures are, however, only preliminary to the identification and direct treatment of the bleeding points. Each of these is seized with Spencer-Wells's forceps, and in the case of the more important ligatured with catgut, silk, or Pagenstecher thread. Torsion will suffice for the smaller vessels. (*See also* Injuries of Arteries.) Heat is a convenient means of arresting hæmorrhage from a large oozing surface: hot lotion is used at a temperature of 115° F. Cold in the form of iced lotion is also used, but is less often available. A solution of adrenalin chloride (1 in 1,000) mopped over the part on pieces of wool is useful in some cases.

(2) **Cleansing of the Wound.**—In the treatment of any wound it is essential to carry out careful and thorough purification of the wound and its neighbourhood. When the lesion is an extensive one the proper performance of this may necessitate the administration of an anæsthetic. Through neglect of this measure the cleansing carried out is often inefficient and disaster results. The wound is first covered with a piece of gauze soaked in antiseptic lotion (carbolic, 1 in 40; perchloride or bin-iodide of mercury, 1 in 2,000). The surrounding skin is then shaved if necessary, and scrubbed well with soap and water. Care should be taken to avoid causing abrasions of the skin; in certain regions, therefore, and in the case of children, a nail-brush may be replaced by gauze swabs. The skin is next treated with one of the antiseptic lotions mentioned above. The gauze is then removed from the wound, and with scrupulous care the cavity and edges of this are disinfected, all dirt, hair, foreign bodies and blood clot being removed. The wound is irrigated with the lotion and finally dried.

(3) **Examination of the Wound.**—A careful and complete

examination of the wound is next to be made. The possibility of the division of important nerve trunks should be remembered, and great care must be taken to decide whether such a lesion has occurred, and to unite accurately the divided nerve ends. Injuries to tendons are also of frequent occurrence in wounds about the wrist or hand, and are too often overlooked. Treatment should be carried out as described in the section on Affections of Tendons. When profuse hæmorrhage has occurred and there is a probability that a main arterial trunk has been injured, search must be made for this, and enlargement of the wound may therefore be necessitated. In punctured wounds, in particular, it is essential that a careful examination be made to decide as to the involvement of nerves, vessels, joints or the peritoneal cavity.

(4) **Drainage.**—Next to be determined is the question as to the necessity or otherwise of providing drainage. Small incised wounds, especially of vascular parts such as the face or scalp, may safely be closed without drainage. Lacerated wounds, those in which an infected or dirty instrument has caused the injury, or in which cleansing of the wound has of necessity been imperfect, and those in which there is likely to be much oozing, should be drained. Deep wounds, that is to say, those which penetrate the deep fascia and involve muscles or other structures, should be drained, even though small and incised. The best method of securing drainage is by means of indiarubber tubes. These should be boiled before use, and may be secured in position by a stitch through the side of the wound. Gauze strips are not infrequently utilised with the intention of securing drainage; they soon become dry and hard and justify their name of "plugging": the discharge escapes when they are removed. The drainage should always be at the most dependent part of the wound, and under such circumstances the making of a counter-opening is called for.

(5) **Closure.**—It is always an advantage to close a wound as completely as is safe. Closure hastens repair and minimises the subsequent scarring. At the same time it must be borne in mind that closure of an infected wound may have serious results. Diffuse cellulitis, pyæmia and septicæmia may ensue after closure in cases in which such sequelæ would have been avoided had the wound been left freely open. On the whole, it is wise for the surgeon to err on the side of leaving wounds open needlessly rather than to risk closing those which after-events show should have been left open. Small incised wounds made with a clean instrument should be closed. Large lacerated wounds with much contusion of the tissues should be left open. Between these two extremes there are many

cases in which doubt may arise, and in which the experience of the surgeon must guide him as to the proper course to take. The following are the chief points to consider in coming to a decision: (*a*) *The possibility of efficient attention being paid to the after-treatment.* When, as in field emergencies, a wound cannot receive the watching and care desirable, closure is contra-indicated. (*b*) *The likelihood of severe infection.* Wounds inflicted by instruments such as may be received in the post-mortem room should not be closed. Wounds which have been grimed with soil, more especially if efficient cleansing has not been possible, should be left open. (*c*) *The amount of contusion of the edges.* When this is slight sutures may be inserted, but should not be too close together, and should be lightly tied. When the amount of contusion is great and necrosis of a considerable amount of tissue is probable, the wound should remain open. It is lightly packed with gauze, and allowed to heal by granulation. (*d*) *The presence of laceration.* Lacerated wounds, as a class, should not be closed, but left open to granulate. When there is much gaping one or two sutures may be inserted and lightly tied in order to lessen this. But any attempt at further closure is dangerous. In the case of a small lacerated wound in an exposed part it may be possible to excise it completely and to suture the incised wound which results. Scarring is thus minimised. (*e*) *Punctured wounds should not be closed.* The proper cleansing and examination of the wound may necessitate its enlargement by incision, which is much preferable to probing. When an incision has been made partial closing may be carried out, a drainage tube being inserted.

Methods of Closure.—In trivial cuts, where there is little separation of the edges, collodion provides an excellent method of treatment. The edges are approximated and collodion is painted over them and the surrounding skin; a thin film of wool or a single layer of gauze is then laid over the wound and collodion painted over this. After five or six days the collodion "scab," as it is called, may be removed by the application of a little ether, and the wound will be found healed. In larger wounds sutures should be employed to approximate the skin edges; of the many suture materials available silkworm gut is the best. For cuts about the face the very fine ophthalmic size is needed. A Hagedorn or bayonet-pointed needle may be employed, and care should be taken to avoid inverting the skin edges: eversion should be aimed at rather than inversion. The sutures must not be pulled too tight, since such a proceeding predisposes to infective processes about the stitch hole. Four methods of inserting the sutures will be briefly mentioned. (*a*) The *interrupted* suture (Fig. 1). The sutures are tied with a reef knot so that the knot lies away from the approximated edges. (*b*) The *buttonhole continuous* suture (Fig. 2).

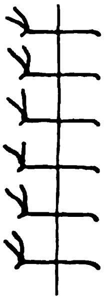

FIG. 1.—Interrupted Sutures.

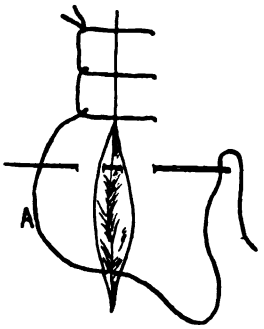

FIG. 2.—The Buttonhole Continuous Suture.

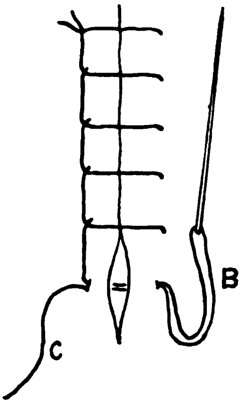

FIG. 3.—Method of finishing off the Buttonhole Continuous Suture. B and C are tied together.

The needle is passed and a knot tied as for an interrupted stitch. The needle is again passed in the same direction through the skin edges, carried over the loop left at A and the suture drawn tight. In order to finish off the stitch the needle is passed in a reverse direction (as in Fig. 3), and the double end B tied in a reef knot with the free end C. The complete stitch is shown in Fig. 4. This suture is rapid in application, and gives excellent approximation. (*c*) The *over-and-over continuous* suture is shown in Fig. 5.

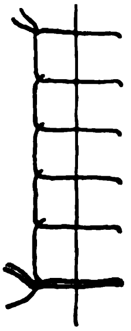

FIG. 4.—The Buttonhole Continuous Suture completed.

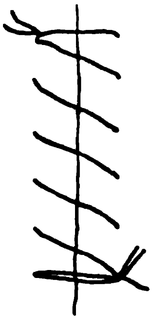

FIG. 5.—The over-and-over Continuous Suture.

It does not secure accurate approximation of the edges, and the scar is liable to be puckered and unsightly. (*d*) The *subcuticular* suture. This is the best method of closing small wounds of the face, since it avoids stitch-holes through the skin, the scars of which are often more obvious afterwards than the scar of the wound itself. The needle is entered ¼ inch from the end of the wound, and in a line with it. Next it is passed through the deeper layers of the skin on one side of the wound, and then similarly on the other (*see* Fig. 6), and finally brought out ¼ inch beyond the termination of the wound. By pulling on the ends of the suture the edges are approximated. To remove the stitch cut one end short and pull on the other in the line of the wound until the whole suture is drawn out. *Michel's clips* are also used for closing wounds, but are inferior to sutures for accidentally inflicted wounds.

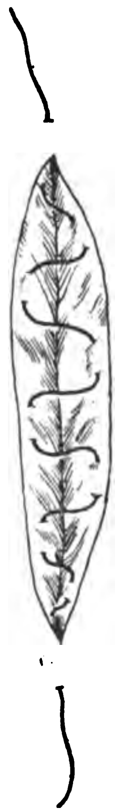

FIG. 6.—The Subcuticular Suture.

(6) **Dressings.**—It is advisable in the case of accidentally inflicted wounds to apply dressings containing antiseptics. Sterilised cyanide gauze or plain sterilised gauze, wrung out of weak carbolic or mercurial lotion and covered with sterilised wool, is generally employed. In the absence of indications to the contrary, such as signs of infection, the dressing may be left undisturbed until the stitches are ready to be removed: this may be done from the fifth to the eighth day. If drainage tubes have been inserted the wound must be dressed daily, or more often if the discharge is profuse, until the tubes are removed. In the absence of infection the tubes may be removed after twenty-four to seventy-two hours, the time varying with the size of the wound and the amount of discharge. There is no advantage in washing out the wound with antiseptics when the dressings are changed.

(7) **Provision of Rest.**—In order to ensure rapid and complete healing rest must be provided. Splints, slings, bandages, or in the case of wounds of the trunk or lower extremity rest in bed, will supply this.

Granulating Wounds.—When the edges of a wound cannot be brought into apposition by ordinary means, healing by granulation must be aimed at. When the wound has become clean, and the time of fear of infection has passed, some form of plastic operation may be devised to close the gap. Apart from this the granulating surface may be skin-grafted by Thiersch's method, and so more rapid healing secured. A most appropriate form of dressing for a granulating surface is green protective, perforated with small holes to allow of escape of discharge and applied directly to the wound. Over this are placed layers of plain sterilised gauze and wool. The dressing is changed daily, the granulating surface being washed over with some non-irritating lotion, such as boracic or normal saline. Ointments, such as boracic or zinc oxide, are also employed. If the granulations become exuberant and raised above the surrounding skin, they should be rubbed lightly with the solid nitrate of silver stick, or lotio rubra (2 gr. of zinc sulphate to 1 oz.) may be applied for a few days.

General Treatment.—In the case of extensive wounds the surgeon will be called upon in the first instance to treat the patient for shock, and often he must take measures to combat the effects of hæmorrhage. The treatment of these conditions is dealt with elsewhere. When the patient has been tided over these immediate accompaniments of a severe wound care should be taken to place him under the most favourable circumstances to facilitate the process of the repair. Rest, as already mentioned, is essential. A purge should be administered at the outset, and attention given to the evacuations throughout the course of treatment. The diet should be light and easily digestible; stimulants are sometimes necessary, and at a later stage tonics in the form of iron, quinine and strychnine are serviceable.

Complications of Wounds.—(1) **Infection.**—After the infliction of a wound of any severity there is slight rise of temperature, lasting for twenty-four to forty-eight hours, unaccompanied by any severe constitutional treatment, and of no special importance. Should, however, infection of the wound take place, the temperature continues to rise, fever becoming marked by the third day: the wound becomes red, hot, painful and throbbing. Prompt treatment is necessary. Stitches are removed, retained discharges are allowed to escape, the wound gently irrigated with weak antiseptic lotion, drainage tubes inserted, and boracic fomentations employed. Counter-incisions for drainage are made if necessary. Under this method of treatment many cases make a rapid recovery, but the more severe septic complications, cellulitis, erysipelas, pyæmia, or septicæmia may follow. The treatment of these conditions may be found elsewhere.

(2) **Vicious Contraction.**—In the case of large wounds causing much loss of substance or destruction of skin, healing must of necessity take place by granulation. More or less contraction must therefore ensue. This contraction may cause great disfigurement;

and may interfere with the movements of important joints. The treatment of such a case must be largely prophylactic. Skin-grafting does much to diminish the contraction of a granulating wound. The application of splints and the use of judicious passive movements during the process of healing are of the greatest importance. Moreover, it must be remembered that a wound does not only contract while healing is taking place, but for some three or four months afterwards. Treatment by means of splints, movement and massage must not therefore be discontinued as soon as the site of the wound is covered with epithelium.

(3) **Keloid.**—This condition is most likely to follow lacerated wounds. Attempts may be made to get rid of the keloid by excising the scar and bringing the edges accurately together. Keloid, however, is likely to develop again at the site of the new scar. X-rays have been highly recommended by some, and the use of fibrolysin has been said to give good results when injected subcutaneously in the region of the scar.

MAYNARD SMITH.

WOUNDS (GUNSHOT).

Gunshot Wounds may involve any region of the body and comprise every degree of injury from the most trivial to the most severe. They are produced by missiles of various kinds, small shot, rifle and pistol bullets, shrapnel bullets, shells of all sizes and their fragments, and the splinters of stone, wood or metal that a shell drives in all directions when it strikes hard ground, a building, or a ship. The treatment of these injuries depends mainly on their situation, nature and extent, but the conditions under which the surgeon works must also be taken into account and often materially modify the treatment. In war, with great numbers of wounded to deal with, a necessarily limited staff, equipment reduced as far as possible for the sake of mobility, and the necessity of moving all the cases away from the front, it is often inadvisable or impossible to employ remedial measures that would undoubtedly be adopted for the same injuries under the ordinary conditions of work in time of peace. In this country gunshot injuries are only occasionally seen and are commonly inflicted by shot-guns or by pistols or rifles of much less power than military weapons, and only in the event of invasion would the practitioner have to treat wounds by the latter.

In all gunshot wounds the prevention of infection is the point of greatest importance. The majority of bullet wounds will heal without suppuration if not contaminated from outside. The wounds should be exposed without dragging the clothing over them, and the clothing should be freely cut open if necessary. If facilities for cleansing the skin are at hand, as when the patient is brought at once to hospital, a wide area of skin round each wound should be shaved, washed with soap and water and disinfected, great care being taken not to let any strong antiseptic touch the wound itself, but if this cannot be done on the spot nothing more than the application of a sterile dressing should be attempted and the cleansing of the skin should be left until it can be done thoroughly and carefully. For first aid in war every civilised nation supplies a portable "first field dressing," which is carried by every soldier. A rapid, simple and excellent method of disinfecting the skin is to paint it with tincture of iodine, without any previous washing. On no account should any gunshot wound be fingered, probed or meddled with in any way, unless there is some definite reason for interference, which must only be carried out with full aseptic precautions. No gunshot wound should be sutured. If the entrance and exit apertures are small and the track remains aseptic the first dressing may usually be left on until the wounds have healed. It needs changing if it becomes soaked with blood or if the wound suppurates.

For **Septic Wounds** the essential thing is to provide good drainage. The exit aperture, being often larger than the entrance, will suffice for drainage in many cases, but if there is any difficulty in getting the track to drain well counter-openings should be made and drainage tubes inserted. Hot boric fomentations, changed frequently, should be used at first, and as the discharge decreases dry sterile dressings may be substituted. Strong antiseptics must on no account be used in vain efforts to "disinfect the wound"; they are worse than useless. Irrigation with very weak lysol or sterile saline, or continuous boric baths, may be useful in very foul wounds. The wounds that are most likely to suppurate are those with large skin apertures, especially if there is much laceration and contusion of the soft parts, as in wounds from fragments of shell, from small shot at very close range, where the charge of shot strikes in a mass and then spreads in the tissues, or from a bullet with very great velocity striking a hard bone, when the exit aperture is large and lacerated from fragments of bone being driven out through it (the so-called "explosive" exit wound). Wounds of the axilla, perineum and feet are very liable to become septic.

Lodged Missiles are generally better left alone. They will do no harm in most cases, if the wound is aseptic, and much harm may be done by injudicious attempts at removal. If a lodged bullet causes pain or interferes with the action of a muscle or the movement of a joint, or if it is keeping up discharge from a sinus, it must be removed. Small shot lodged superficially should not be touched unless they cause disfigurement, or are in some region where it is dangerous to leave them, as in the eye. If a bullet needs removing, no attempt should be made to drag it out through the wound. It must be accurately localised by skiagrams, and cut down upon by the most convenient route, without regard to the track by which it entered.

The **pain and shock** of any severe wound must be relieved by means of stimulants, hot soup or beef-tea, and morphine, provided there is no contra-indication. In very bad cases normal saline solution may be given by the rectum, subcutaneously or directly into a vein. The injured part should be kept at rest on a splint, if necessary, until healing is complete.

Hæmorrhage.—Slight hæmorrhage will often yield to pressure by means of a dressing firmly applied. The danger of gangrene from arrest of the circulation must never be forgotten, and the pressure must be relaxed within a few hours, twelve at latest. The wound should not be plugged unless in an emergency when the bleeding cannot be stopped in any other way. Plugging is almost certain to cause infection. Tourniquets are also dangerous, and should be used only in emergency and removed at the earliest possible moment. Arterial hæmorrhage occurs either externally or into the tissues, owing to the narrow bullet track becoming obstructed. In either case the treatment is the same. If the bleeding is slight or tends to cease nothing need be done beyond keeping the patient quiet, raising the part, keeping a careful watch, and having everything in readiness for operation. If the bleeding is severe, or if there is great tension of the part from interstitial hæmorrhage, the bleeding vessel must be exposed at the injured spot and secured by ligatures above and below the lesion. This is done by enlarging the wound freely, the vessel being controlled by pressure higher up, and on relaxing the pressure the bleeding point can usually be found. Pressure forceps may be left on for twenty-four to forty-eight hours if it is difficult to apply ligatures. Suture of the arterial wall is seldom possible, as there is a notch or perforation in it with loss of substance, like a hole in a rubber drainage tube. In interstitial hæmorrhage it is important to open up the cavity and turn out the clot, so as to relieve pressure which threatens to cause gangrene.

Ligature of the main artery on the proximal side for hæmorrhage should be avoided if possible, but if it is impossible to secure the vessel at the wounded point, or if for any reason the attempt to do so is considered inadvisable, proximal ligature may be done; but there is always increased risk of gangrene, and on the other hand the bleeding may continue if the collateral circulation is very free. For uncontrollable bleeding amputation has been done, but this is a desperate remedy and should scarcely ever be necessary.

Secondary Hæmorrhage is not an uncommon complication of septic gunshot wounds. The treatment is on the same lines as for primary hæmorrhage, with the important difference that secondary hæmorrhage demands immediate operation, even if it has ceased temporarily, and delay or temporising is dangerous. The vessel should be secured at the injured spot if possible; failing this, proximal ligature should be done, or as a last resort amputation, should bleeding continue or gangrene occur after ligature. In a septic wound absorbable ligatures should always be used.

Traumatic Aneurysms and Arterio-venous Communications require complete rest of the part and of the patient for a considerable time. Spontaneous cure may occur in some cases. Aneurysmal varix needs no operative interference. Traumatic and varicose aneurysms are treated just as ordinary aneurysms, by ligature of the artery close above and below the sac, with or without extirpation of the sac. Where the vessel is small it may be better to lay open the sac and secure the artery through it. Matas's operation of endo-aneurysmorraphy may be done in suitable cases. Proximal ligature is useful in traumatic aneurysms, but in varicose aneurysms it gave very bad results in the South African war, gangrene following in a considerable proportion of the cases.

Injuries of Nerves.—In addition to the usual care to prevent infection of the wound, rest on a splint in such a position as to relax the injured nerve and daily stimulation of the paralysed muscles with the constant current are necessary. As soon as the wounds have healed massage should be carried out regularly. Great care should be taken to preserve the mobility of the joints and to prevent shortening of the unopposed muscles.

The question of operation is not a simple one. A bullet at high velocity passing close to a nerve may produce a physiological lesion of it without any anatomical damage, the vibrations caused by the passage of the bullet being able to interrupt the conducting power of the axis cylinders. This is usually spoken of as "concussion" of a nerve, and is peculiar to bullet wounds. In the slighter degrees of concussion the functions of the nerve are regained in a few days, but severe concussion causes degeneration of the axis cylinders, and recovery does not take place till these have regenerated, which may take many months. These severe concussion effects cannot be distinguished from anatomical division of the nerve. In military practice the rule is to wait in doubtful cases before operating, and if in six weeks or two months there is no improvement then the nerve should be exposed, though even then it may be found apparently intact, the symptoms being due to concussion. In the wounds likely to be seen in civil practice severe concussion will rarely be met with, as most of the injuries will be from missiles at low velocity. In such a wound, from small shot or a pistol bullet, or a rifle bullet at a long range, if there are symptoms of division of a nerve the wound should be enlarged, the nerve examined, and primary suture done if it is found divided. The important points in suturing a nerve are to handle the nerve as little as possible, never to grasp it with forceps, but to hold it by its sheath, to smooth the ragged ends with a very sharp knife, not with scissors, and to approximate the ends with fine catgut sutures passed through the whole thickness of the nerve with a round sewing needle. Large nerves may be sutured by their sheaths; a small nerve requires only a single suture right through it. The after-treatment is that already given for wounds of nerves, and must be persevered with until recovery is complete. It is useless to suture a nerve in a septic wound (*see* Injuries of Nerves, Vol. II.).

Gunshot Fractures require the same treatment as any compound fracture with a considerable amount of comminution. Everything depends on keeping the wound aseptic, and the greatest care should be taken with the first dressing. As comminution is often very extensive, several inches of a bone being reduced to small fragments in bad cases, the position of the limb, and especially its length, must be carefully watched, and sufficient extension used to minimise the amount of shortening. When the muscles recover their tone, after the shock of the wound passes off, considerable deformity may be brought about in a fracture that was at first in good position. It is most important to avoid tight bandaging or tightly applied splints, particularly in the upper limb, and the usual rule of examining every fracture shortly after it has been put up, to detect any interference with the circulation, must be strictly adhered to.

For fixation the surgeon should use the splints he is accustomed to. Hard and fast rules cannot be laid down, as the requirements of different cases vary very much, and every surgeon has his own favourite methods of putting up fractures. Special mention may be made of cardboard splints with starched bandages for the upper limb, of Hodgen's splint for the femur, and of Croft's lateral plaster splints for the leg. As there is generally free mobility at the site of fracture, it is not advisable to commence movement of the fractured limb very early. A large amount of callus is formed and consolidation is slow, and until the external wounds have healed and the callus is getting firm not much in the way of movement should be done. Massage should be begun as soon as the wounds have healed.

In *Septic Fractures* many of the smaller fragments will necrose and greatly delay recovery. It is necessary to enlarge the exit wound and freely remove all small and completely detached fragments. Larger pieces that are still attached by periosteum may be left. Most of the small fragments will be found in the neighbourhood of the exit wound. Drainage must be efficient, and as daily change of dressings is necessary an interrupted splint must be used, or a plaster case with a window when the amount of discharge is small.

Fractures are most likely to suppurate when there is great comminution and the exit wound is enlarged by fragments driven through it.

Operations for wiring, screwing or plating the fractured ends are seldom practicable and never necessary in recent gunshot fractures. They are required only in the event of non-union or mal-union.

Amputation for gunshot fracture is necessary only when the vitality of the limb is destroyed by very extensive damage to the soft parts, for gangrene, or if sepsis threatens the patient's life. A limb which is useless and painful from nerve injury or from non-union may have to be removed when all other treatment has failed.

Wounds of Joints, if aseptic, usually recover with good movement. They require careful first dressing, rest on a splint in the position that will give the most useful limb should ankylosis occur, and careful massage and daily movement as soon as the external wounds have healed. The effusion of blood into the joint is best left alone; it will become absorbed in from two to four weeks, but if the amount of blood is very large and absorption is slow aspiration may be done, great care being taken not to infect the joint, but not before the skin wounds have closed, lest the aspiration draw infection in through the open wounds. If the articular ends of the bones are comminuted considerable interference with movement may result, or even complete ankylosis. This is particularly to be feared in the elbow, and may require a late resection to restore movement. Infection of a wounded joint calls for the usual energetic treatment of septic arthritis. The joint cavity must be freely laid open, irrigated with sterile saline or a very weak antiseptic, such as boric lotion, and rigid fixation and free drainage kept up until the suppuration subsides. Ankylosis is the common result, though exceptionally some movement is regained. In these cases amputation is often necessary to save the patient's life. Primary amputation for a wound of a joint may be required when the soft parts are extensively destroyed. Excision has been abandoned as a routine measure in the treatment of gunshot wounds of joints, though in a septic joint with comminution of the ends of the bones fragments must be removed, and this amounts to a partial excision. If this has to be done in the elbow it is probably better to perform a complete excision, as partial excision of the elbow gives very bad functional results.

Fractures of the Skull invariably require operation. Fragments of bone are carried into the brain, even when the amount of damage to the skull appears to be very slight. These must be removed, as if left they will set up encephalitis and possibly a cerebral abscess. It is better to shave and cleanse the whole of the scalp. A flap should be turned down round each wound, or if the two wounds are close together they may both be included in the same flap, which should consist of all the soft parts and the pericranium. The bullet holes should be enlarged with gouge forceps; a trephine is seldom needed. All sharp edges of bone must be smoothed off, any depressed portions elevated, and with the sterilised little finger the track of the bullet should be gently explored in search of pieces of bone. Some fragments will often be found driven sideways beneath the edges of the apertures in the skull. All fragments must be removed from the brain, and some may be found at a depth of 1½ to 2 inches. Search for a lodged bullet is not permissible, but if it is felt it should be removed. The dura mater should be sutured as completely as possible, unless the wound is septic. Opinions differ as to the advisability of inserting gold or platinum foil beneath the dura to prevent adhesions; on the whole, it seems probable that it does little good, if any. It is better not to replace any portions of bone unless they are of large size and the wound is aseptic. The incision should be completely closed, as the bullet hole gives good drainage. The usual treatment of any head injury, rest, quiet, low diet, attention to the bowels and bladder, must be carried out.

A cerebral abscess may form in the bullet track, and is readily found and evacuated. Later, abscesses may form round fragments of bone that have been left in the brain; these also are found without difficulty, as they are always close to the bullet track. They must be opened and drained as soon as diagnosed.

Wounds of the Face may result in a good deal of mutilation, and may require various plastic operations for their repair. This is especially the case with wounds at very short range from shotguns. Fractures of the jaws require removal of loose teeth and fragments of bone, very careful cleansing of the mouth from the first, and fixation of the chin by means of a four-tailed bandage and a gutta-percha splint in fracture of the lower jaw. Any more elaborate splint is seldom needed, as the opposing jaw gives excellent support to the fractured one. Wound of the orbit often involves destruction of the eye, and orbital cellulitis may follow. Removal of the damaged eye and free drainage are required. Small shot lodged in the eyeball almost invariably necessitate removal of the eye (*see* Injuries of Eye, Vol. III.).

The treatment of **Wounds of the Spine** with paraplegia is chiefly palliative and is the same as that of ordinary cases of fracture-dislocation. As there is no actual fracture of the spinal column, which is merely perforated by the bullet, no special fixation apparatus is required, but absolute rest is essential. Regular catheterisation is usually necessary, and extreme care must be taken in the disinfection of the catheter, the surgeon's hands and the meatus. Even the most careful nursing generally fails to prevent the formation of bedsores, and these need cleansing and dressing daily. Laminectomy is useless unless there is clear evidence of pressure on the cord by spinal hæmorrhage, a displaced fragment of bone, or a lodged bullet, with incomplete paraplegia or possibly some early improvement in the symptoms. Pain is often extremely severe and uncontrollable, and if it is due to spinal hæmorrhage irritating the nerve roots laminectomy may be justifiable for its relief.

Wounds of the Neck are chiefly flesh wounds and require cleansing and dressing as usual. Injury to the vessels or nerves must be treated as previously described. Injuries to the spine have also been dealt with. Wound of the larynx may necessitate tracheotomy if there is danger of asphyxia from hæmorrhage or from œdema. Surgical emphysema of the neck from wound of the larynx or trachea may be very extensive, but as a rule requires no special treatment. If the wound is septic, and especially if there is also a wound of the pharynx or œsophagus, there is great danger of septic pneumonia, and it may be necessary to do a low tracheotomy to prevent the inspiration of septic material.

In wounds of the pharynx and œsophagus the danger is spreading cellulitis deep in the neck. Free drainage must be ensured, the wound must be enlarged and a tube put right down to the aperture in the œsophagus, and the raw surface round the tube packed with gauze to protect it from infection. It is generally impossible to suture the hole in the œsophagus, as there is loss of substance, and stitches with tension on them in a septic wound will not hold. Nothing must be given by the mouth for several days, after which a stomach tube may be passed and food given through it.

Penetrating Wounds of the Chest, if uncomplicated, usually require nothing more than rest, with attention to the external wounds. Hæmoptysis does not often need any treatment, but if it does copious inhalation of amyl-nitrite is the best remedy, or morphine may be given. Hæmothorax should generally be left alone to become absorbed spontaneously. Should it cause serious pressure symptoms or be very slowly absorbed aspiration may be done with strict aseptic care. Incision of a hæmothorax is almost certain to result in infection of the pleural cavity, and should never be done. Empyema requires the usual treatment by excision of a portion of a rib and drainage.

The wounds of the chest that are most dangerous and difficult to treat are those inflicted by large missiles, or by small shot at very close range, with a large wound in the chest wall, collapse of the lung, and infection of the pleural cavity by the carrying in of portions of the clothing. Thorough cleansing of the wound, removal of fragments of bone and foreign bodies, and free drainage are necessary. Fractures of the ribs need nothing more than support by means of a firm bandage.

Wounds of the Heart, if not immediately fatal, may sometimes be dealt with by prompt operation and suture of the heart wall, the pericardium being exposed by free removal of the costal cartilages on the left side, and care being taken not to open the pleura if it can be avoided. In septic pericarditis following a gunshot wound, the diagnosis having been established by aspiration, drainage may be effected by removal of the sixth left costal cartilage and incision of the pericardium.

Penetrating Wounds of the Abdomen, in military practice, are generally treated without operation, as experience in recent wars has proved that better results are got by not operating under the conditions of active service; and with as complete rest as possible, rectal feeding, and opium more than half the cases recover. To this general rule there are certain exceptions; if there is obviously fæcal contamination of the peritoneal cavity, if internal hæmorrhage is going on, or if in the course of two or three days symptoms of peritoneal infection appear, then without operation the case is hopeless and immediate operation gives the only chance of saving the patient.

In civil practice the difficulties of field surgery have not to be faced, the patient is generally seen very soon after the injury, and in every case of penetration of the abdomen immediate laparotomy should be undertaken and the damage to the abdominal contents repaired. Bleeding vessels in the mesentery or omentum must be tied, and bleeding from solid organs arrested by deep sutures or by plugging with gauze. Careful and systematic search must be made for holes in the stomach and intestine; these may be numerous but can usually be found by the ecchymosis of the intestinal wall that surrounds them. The apertures must be closed by suture in such a way as not to narrow the lumen of the gut. A badly damaged portion of intestine may have to be resected and an end-to-end anastomosis made. If the patient's condition is too bad to allow of a long operation it may be necessary to bring a wounded loop of bowel to the surface and establish an artificial anus, but this is to be avoided if possible. It is perhaps better to drain the abdomen for twenty-four to forty-eight hours after an operation of this nature, though many surgeons close it without drainage. In the after-treatment the semi-recumbent position is important, and continuous rectal injection of warm saline solution helps to combat shock and relieve thirst. Fluid food may be given early, as there is little danger of leakage from properly sutured wounds of the alimentary canal.

In cases where early laparotomy has not been done general peritonitis may develop in two or three days. Here the abdominal cavity must be drained by means of several small incisions, tubes being put into the pelvis, each iliac fossa, and the renal pouch on each side through openings made by cutting down on the end of a long pair of forceps passed into the flank from the anterior incision. Lymph should be disturbed as little as possible, and nothing in the way of sponging out the peritoneum should be done. Flushing out the peritoneal cavity is advocated by some, condemned by others; probably it is better not to flush. Rapid work is essential.

Wounds of the retro-peritoneal surface of the colon cause dangerous cellulitis. Free drainage is necessary; the wound should be enlarged and either the bowel brought to the surface and stitched there, or a tube put into the bowel and the wound packed round the tube. It is useless to try to suture the bowel. Localised abscesses may follow a wound of the large intestine and must be opened and drained. In wounds of the rectum the fæces must be prevented from passing along the bullet track, either by colotomy, or better by dividing the sphincters so as to cause temporary incontinence and prevent fæces accumulating in the rectum.

Wounds of the liver and stomach may be followed by subphrenic abscess or by biliary fistula. Drainage is needed in either case. Wound of the spleen may necessitate splenectomy if the bleeding cannot be stopped otherwise. Wound of the pancreas is dangerous from hæmorrhage and from escape of the irritating pancreatic secretion into the peritoneum. Deep sutures to arrest bleeding and gauze drainage to absorb the secretion are required. Wounds of the kidney rarely need any special treatment, unless a peri-renal abscess or cellulitis calls for incision and drainage. Wounds of the bladder, if intra-peritoneal, must be sutured after opening the abdomen; if extra-peritoneal, free external drainage is necessary, and cellulitis from extravasation of urine may require free incisions. The bladder must in either case be kept empty, by tying in a catheter or by draining it either supra-pubically or through a median perineal incision. Injuries of the urethra should be repaired, if possible, by suturing the urethra over a soft catheter, and extravasation of urine must be watched for. Wounds of the external genitals are seldom of much importance, though a badly damaged and suppurating testicle may have to be removed.

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INJURIES AND DISEASES OF BONES.

FRACTURES.

GENERAL PRINCIPLES OF TREATMENT.

THE immediate temporary treatment of a fracture is of the greatest importance. The injury usually occurs while the patient is following his occupation or in the open street. He thus has to be conveyed either to his home or to a hospital, and unless this is done with the necessary care the severity of the injury may be greatly increased.

Thus in the case of fractures of the lower extremity, especially of the tibia and fibula, many a simple fracture has been converted into a compound or open fracture owing to the well-meaning efforts of ignorant bystanders to help the injured person to his feet. An attempt to stand or walk may force the sharp end of one of the fragments through the skin.

In the case of a fracture of one of the bones of the upper extremity all that is required to support the injured limb is a sling until the patient is conveyed to his home or to a hospital, when the nature and extent of the injury can be more fully investigated.

In the case of a fracture of one of the bones of the lower extremity further precautions are necessary. Some temporary splint must be attached to the injured limb while the patient is being moved. Splints may be improvised from any handy piece of board, and in the absence of anything else walking-sticks or umbrellas may be bound to the injured part, or the two legs may be bound together with handkerchiefs, so that the sound limb acts as a splint. The patient must be transferred in the recumbent position on some form of stretcher. On his arrival at the hospital, clothes should be removed from the injured limb by cutting up the seams, as efforts to remove them in the ordinary way will cause great pain, and are liable to increase the severity of the injury. In the case of fractures of the spine or of the pelvis the patient must be moved in a horizontal position on a stretcher, and the greatest care must be taken to avoid any increase of displacement, which would probably lead to increased injury to the spinal cord or pelvic viscera.

After the fracture has been examined, and its position and character exactly ascertained, the permanent treatment can be commenced.

This may be started at once, or an interval may be allowed to elapse if there is much shock or a very marked amount of swelling.

The General Principles of Local Treatment may be considered under the following heads: (1) To reduce the fracture and get the broken ends into apposition; (2) to keep the fracture in good position by the use of some form of apparatus; (3) to maintain the nutrition of the injured part, and to restore the function of the injured limb; (4) to treat any local complications.

In addition to these, general treatment will be necessary, and will depend on the age, constitution and general condition of the patient, and on the position of the fracture and the presence or absence of complications.

Though as a general rule all the above principles have to be considered in the treatment of every fracture, yet special circumstances may render one of them of paramount importance, the others being of far less moment. Thus in certain fractures it is of the greatest importance to get the fractured ends into exact position, and by some apparatus to keep them in this position.

In some cases the essential point may be to maintain the nutrition of the limb and prevent stiffness and adhesions by massage and movements, even at the expense of accurate apposition of the fragments.

In others there may be some complication, such as the injury of some important viscus, which may threaten the patient's life, and be far more serious than the fracture itself. In this case the treatment will be directed chiefly to the complication.

When a fracture occurs in old people, general treatment is often of the greatest importance, and may have to be carried out at the expense of the local treatment.

Again, when we have to deal with a spontaneous fracture, the injury may be a comparatively unimportant symptom of a far more serious disease.

(1) Reduction.—By reduction of a fracture is meant bringing the fractured ends of the bones into apposition, and thus removing the deformity both of the bone and of the limb. It may at once be stated that in the majority of cases it is impossible to get the fractured ends into exact position by manipulation. Fortunately in most cases a thoroughly sound and serviceable limb is obtained, and firm union results if the fragments are only brought into approximate position. Indeed in some fractures (the shaft of the fibula and ribs, for instance) it is useless to attempt the reduction of the fracture. No manipulations can bring about reduction, and none are necessary. Firm union, nevertheless, occurs. To understand the difficulties in reducing the fracture it is necessary to consider the causes of the displacement. These are essentially: (1) The effusion of blood at the site of the injury; (2) muscular contraction and spasm; (3) the direction of the force which caused the injury, and the weight of the limb.

In different fractures either of these may be the chief cause of the deformity. Effusion of blood beneath the deep fascia is a very important cause of shortening of the limb. The diameter of the fascial sheath at the site of injury is increased at the expense of its length, and, especially if the fracture is oblique, a very marked shortening of the limb will ensue, which it may be a matter of great difficulty to overcome. Indeed, if reduction is not effected shortly after the injury, before the swelling has appeared, it is better to allow some time to elapse until the exudation has been partially absorbed.

Muscular spasm and contraction is another important cause of displacement. It may, however, be overcome by the administration of an anæsthetic, or by tenotomy of the tendon of the offending muscle. One of the most important effects of massage is the relief of muscular spasm.

Deformities due to the direction of the force which causes the injury, or to the weight of the limb, are often very marked, but can usually be easily corrected by bringing the distal fragment into line with the proximal and applying extension, an assistant at the same time steadying and applying counter-extension to the proximal part of the limb.

A greenstick fracture usually shows a marked angular deformity which can be corrected by forcibly bending the bone back into its original position.

The deformity associated with an *impacted fracture* is often very pronounced, and may be discussed under this heading. This suggests the question: Is it advisable to break down an impacted fracture? The answer to this depends partly on the situation of the fracture, but chiefly on the age of the patient. There will nearly always be considerable shortening, and as the injury will usually be at the extremity of a long bone, serious impairment of function is likely to result.

The general rule is that in a healthy young adult the impaction should be broken down, but that in old people it is best left alone. In them there is probably some atrophy or degeneration of the cancellous tissue, and if the impaction is reduced a gap is left between the fractured ends owing to the crushing of the degenerate spongy bone, and an interval may thus be left of such extent that proper repair is impossible.

Having considered the causes of displacement and deformity at the site of fracture, we can now consider the factors which hinder reduction and so frequently make the exact coaptation of the fragments impossible. The importance of the shortening resulting from the effusion of blood and muscular spasm has been pointed out. Other difficulties are caused by the position and character of the fracture. Such are: (1) The small size of one of the fragments. This difficulty is especially met with in fractures near the extremity of one of the long bones: a fracture of the surgical or anatomical neck of the humerus is a good example of this. (2) The irregularity of the broken ends, leaving several projections and depressions which it is usually impossible to make exactly fit into one another. (3) One of the fragments may, owing to the force of the original injury, have been forced through muscle or fascia so that soft parts separate the fragments. It may under these circumstances be impossible to bring them together.

The reduction, or "setting," of a fracture is usually effected by manipulation. The method usually adopted is to apply extension to the fractured limb beyond the fracture, an assistant meantime applying counter-extension to the proximal fragment, usually by fixing the limb at its junction with the trunk. Lateral pressure is also made by the surgeon when necessary at the site of the fracture. Occasionally a movement of rotation must be combined with that of extension, and in many cases reduction is aided by relaxing the muscles of the affected part; for instance, flexion of the hip in fractures of the shaft of the femur to relax the quadriceps extensor or of the knee to relax the hamstrings.

In many cases an anæsthetic is desirable. This, in addition to abolishing muscular action, enables the surgeon to be more methodical and less hurried in his manipulations.

The coaptation thus obtained is usually only approximate, but in the great majority of fractures this approximate reduction is all that is required to get firm union and a useful limb.

In other cases, however, this is by no means the case, and it may then be necessary to secure accurate position by cutting down on the fracture, bringing the fragments into position, and securing them by plates, screws, wires, or pegs.

This subject will be fully treated in the section on the operative treatment of fractures. It may, however, be stated here that this method is especially of use in (1) fractures of the shafts of the long bones in which there is extensive displacement which cannot be satisfactorily reduced, due either to the character of the fracture or the intervention of soft parts between the fractured ends; (2) fractures of the tibia and fibula in the region of the ankle-joint; (3) fractures through the upper end of the humerus.

(2) **Immobilisation.**—Having reduced the fracture, we have now to consider the various methods by which the fractured ends are maintained in position. Occasionally some arrangement of bandages or of adhesive strapping is of service as a retentive apparatus, but usually *some form of splint* has to be used. The splint should maintain the fracture in position, keep the injured part at rest, and supply the limb with the support and rigidity which has been lost by the injury.

Generally speaking, the splint should keep at rest the muscles attached to both the fragments, and so should immobilise the joints above and below the fracture. The chief characters of a good splint are that it should be rigid, and at the same time light, comfortable and easily applied. It should also not press too much on bony points, and should be easily removable, so that massage and passive movements may be applied in the neighbourhood of the fracture.

In applying any form of splint the greatest care must be taken to ensure that bandages are not too tightly applied. A tight bandage will certainly impede the venous return, and it must also be remembered that the injury may already have interfered with the circulation to a certain extent, and that swelling may still be going on beneath the splint. These factors may easily lead to gangrene of the limb, and this, being essentially due to impeded venous return, will be moist in character. When splints are applied to a limb the fingers or toes should always remain uncovered, and should be inspected from time to time to make sure that they remain warm and that the colour remains unaltered. Should they become at all blue, or cold and swollen, the splint must be removed and re-applied more loosely.

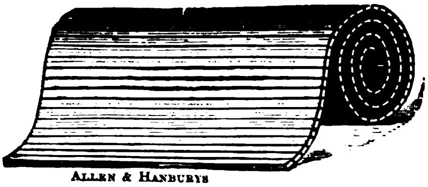
Occasionally, too, a form of local gangrene beneath the splint, known as "splint sore," may occur. Owing to pressure on the skin between the splint and a subcutaneous bony point it may slough, the wound may be deep, and even expose the bone, which may necrose and leave a raw surface, which will take a very long time to heal.

Splint sores are commoner in elderly people, and may be avoided by seeing that the splint is well padded where it rests against bony prominences, such as the heel, malleoli, or condyles of the humerus.

Another serious trouble which may arise from too tight bandaging is Volkmann's contraction. This is a rapid muscular degeneration, caused by interference with the blood-supply of the muscles. The actual muscular tissue tends to disappear and is replaced by fibrous tissue, which by its contraction causes the deformity. It is most commonly met with in fractures of the forearm or fractures in the neighbourhood of the elbow. It must also be remembered that prolonged immobilisation interferes with the nutrition of the muscles, and is likely to lead to stiffness and adhesions in joints and tendon sheaths. The splint should, therefore, be removed from time to time to ensure that this does not occur.

Various Forms of Retentive Apparatus.—In some fractures none is required. This is especially the case in some fractures of the upper extremity, where there is little or no displacement, and where, owing to the importance of getting free movement, massage and passive movements should be started at once. In these cases the injured member will be supported in a sling, or kept at rest between sandbags.

In other cases, bandages or strapping are all that is required. This is especially the case in fractures where the application of rigid apparatus is impossible or undesirable, and all that is required is to limit movement and keep the muscles at rest as much as possible. Fractures of the ribs, clavicle, and sometimes the jaw may be treated in this manner.



ALLEN & HANBURYS

FIG. 1.—Gooch's Splinting.

The most commonly used form of rigid apparatus is the wooden splint. This consists of a piece of thin but strong board, which will vary in length and breadth according to the size of the limb to which it is to be applied.

Before use all splints must be thickly and uniformly padded with tow or wool, which may be kept in position either by bandages or linen sewn round the board. Where there is any wound a thick piece of guttapercha tissue should be used as an additional covering. Wooden splints moulded to the shape of the limb are occasionally used, but, as a rule, there is no special advantage in using them, as any benefit derived from the moulding is to a great extent obscured by the padding.

Another form of wooden splint sometimes used is "Gooch's splinting" (see Fig. 1). This consists of a number of long, thin and narrow pieces of wood arranged in a parallel manner, and connected together by a broad sheet of plaster applied to one side. The result is that the splint can be folded around the limb, and is yet quite stiff in the longitudinal direction. The effectiveness of Gooch's splinting is discounted to a considerable extent by the fact that the limb is not cylindrical, but its diameter varies considerably at different levels.

Metal splints, either in the form of troughs or pieces of galvanised wire-netting moulded to the limb, are occasionally used.

Occasionally a splint made of leather or poroplastic can be used with advantage. These materials can be softened, the former by soaking in dilute acetic acid and the latter by heat, and accurately moulded to the part. They are then bandaged on and allowed to set *in situ*. When quite hard they are removed, and form an accurate mould of the affected region. Eyelet holes may then be punched, and the splint is ready to be secured in position by a lace. This form of splint is frequently used for the shoulder, and is especially useful as a later form of support when some union has occurred, as it can be readily removed for daily massage and passive movement.

Another extremely useful form of moulded splint is made with plaster of paris. It is efficient, easily applied, and is cheap. It is especially indicated in fractures of the lower extremity, as it allows the patient to get about on crutches quite early, and at the same time can easily be removed for daily massage and passive movements. When there is but little swelling it may be applied at once, but when there is much swelling it is best to keep the limb on a splint until the swelling has subsided.

Before the plaster is applied a stocking must be placed on the injured limb, or a thick flannel bandage must be applied from the toes to the upper limit of the splint. Plaster bandages should not be used, as these are liable to dangerously constrict the limb, and the splint cannot be easily cut up. A plaster splint is best applied in the form of Croft's splint or the Bavarian splint.

The former consists essentially of two side splints, each consisting of two layers of house-flannel accurately cut out to fit the limb. The outer layer of flannel on each side is soaked in plaster of paris, and the splint is bandaged on with starch bandages.

The Bavarian splint is similar, but the inner layer of flannel is sewn round the limb; an outer layer of flannel is cut to measure. The plaster is applied to the contiguous surfaces of the two layers, and the whole is bandaged on.

The first stage in the application of a Croft's splint is to cut out four pieces of coarse flannel each of which is so shaped as to measure throughout its extent half the circumference of the limb. The splint should extend from the upper third of the thigh to the balls of the toes, and hence, in order to ensure an accurate fit, the following measurements are necessary (*see* Fig. 2):—(1) Round the upper part of the thigh; (2) round the thigh immediately above the knee; (3) round the patella; (4) round the leg immediately below the knee; (5) round the calf; (6) round the leg above the malleoli; (7) from a point in front of the ankle-joint: (a) round the heel, (b) round the malleoli, and (c) round the sole of the foot; (8) round the heads of the metatarsals. In each case half the circumference of the limb is taken and is carefully marked out at the appropriate level on the sheet of flannel. We have now internal and external lateral splints each composed of two layers of flannel and so shaped as to exactly encircle the limb. The outer pieces of flannel of each lateral splint are thoroughly soaked in plaster of paris freshly mixed with water till it assumes a creamy consistency. They are then placed over the two inner pieces of flannel, and the surgeon and an assistant then bring these two lateral splints into position so that the unsoaked flannel is against the patient's leg. Especial care must be taken to secure an exact fit in the region of the ankle. A second assistant now bandages the splint in position, using starched muslin bandages which have been soaked in warm water. Extension is made while the plaster is setting, and care must be taken to ensure that there is no plantar flexion of the foot. The splint can readily be cut up on the following day and afterwards is secured in position with a bandage.

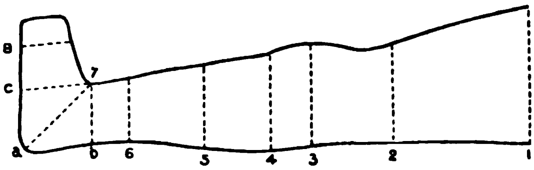


FIG. 2.—Flannel cut for Croft's Splint, showing measurements required.

For a Bavarian splint two rectangular pieces of flannel are required. Each should be of sufficient length to extend from the upper part of the thigh to a point beyond the heel corresponding to the length of the foot; the width should slightly exceed the maximum circumference of the thigh. The position of the heel is marked out, and the two pieces of flannel are then sewn together along the mid line from this point to their upper end. The two layers are placed in position behind the leg, and the inner is then brought round the sides of the limb and sewn along the front of the leg and the dorsum of the foot. The portion of the inner layer beyond the heel is then pinched up and sewn close to the sole of the foot. The superfluous material is then cut away about an inch beyond the stitches so that the leg and foot are enclosed in a tightly fitting stocking of flannel. The outer layer is then stretched round the leg and cut away on each side close to the seam of the sewn inner layer. Plaster of paris is now mixed with water, and the creamy material is poured in between the two layers. Care must be taken to see that it is uniformly applied, especially in the region of the ankle. When it has been well rubbed in to the outer surface of the inner layer and the inner surface of the outer layer, the latter is adjusted to the lateral aspects of the leg. Starched bandages are then applied by an assistant while the surgeon extends the limb and attends to the position of the foot.

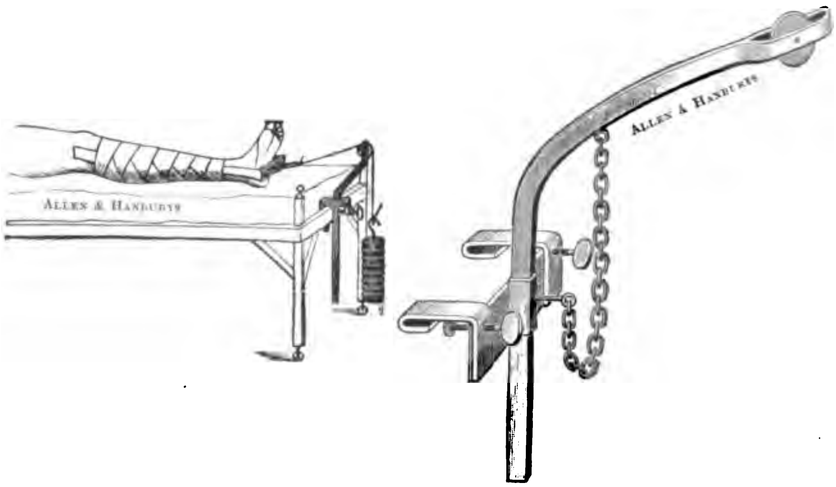


FIG. 3.—Pulley Extension Apparatus.

The toes must be carefully watched after the application of these splints, which after two or three days may be readily cut up along the anterior seam. The edges may be protected by strips of adhesive strapping to prevent fraying, and the splint is then re-applied and held in position by ordinary bandages.

If the fracture is compound, or if there is a window may be cut to facilitate dressing. If necessary, strips of tin may be applied between the layers of flannel to strengthen the splint. Bandages or flannel soaked in glue or sodium silicate may be used instead of plaster of paris. These take longer to set than plaster splints, are lighter, but not so rigid.

Another important method of maintaining fractures in position depends upon the principle of *extension.* It has been pointed out that in many fractures, if the muscles are relaxed, extension of the lower fragment in the axis of the upper draws the fractured ends into good position. One method of applying extension is by the weight and pulley. A stirrup is fixed to the injured limb; from it a cord passes over a pulley at the end of the bed. A weight attached to this provides the extension (*see* Fig. 3). Hodgen's splint for fracture of the femur keeps up continual extension; the fractured limb is raised in a sling, which is fixed to a support at the end of the bed, so that the weight of the body is the force which keeps up extension.

In young children a fractured femur is frequently treated by suspending the child by the legs from a bar passing across the bed. The weight of the body here also is the extending force.

(3) **Massage and Passive Movements.** — When treating a fracture the surgeon should endeavour to obtain firm union of the broken bones in good position. For the final result to be satisfactory it is also necessary that the injured part should completely regain its normal power and functions. The chief means of ensuring this is the employment of massage and passive movements.

A fracture, especially of one of the long bones of a limb, is frequently followed by pain, stiffness, or swelling, which may be very difficult to get rid of, and may even result in some permanent disability.

These troublesome sequelæ are due to the following causes, which to a large extent depend upon the interference with the nutrition and normal functions of the part resulting from prolonged immobilisation :

(*a*) *Muscular atrophy and contractions.*—This is partly the result of disuse, and partly due to contusion and laceration of the muscles themselves at the time of injury. Permanent contraction and shortening of the muscles may follow, leading to some deformity of a neighbouring joint.

(*b*) *Stiffness and pains in the joints.*—This is particularly likely to occur if the line of fracture crosses the articular surface, or is in close proximity to it, as is the case in fractures of the ends of the long bones. The pain and loss of mobility usually depend upon the presence of adhesions between the articular surfaces, resulting from the organisation of the effused blood and inflammatory products which follow the injury. The loss of movement may also be due to excess of callus, which forms a mechanical obstacle to the normal mobility of the joint.

Pain and stiffness are, however, not infrequently present in articulations at some distance from the site of fracture. This is especially likely to be the case in elderly patients whose joints probably show some osteo-arthritic change before the injury. In such patients the impairment of nutrition brought about by immobilisation is likely to increase the arthritis. In a healthy person, too, prolonged fixation will lead to a loss of suppleness in the ligaments, and to changes in the peri-articular structures, usually only of a temporary character.

(*c*) *Stiffness and painful action of tendons.*—This troublesome sequela is especially likely to occur where tendons are in close relation to the fractured bone, as in Colles's fracture of the radius. As the result of the injury effusion takes place into the tendon sheaths. This subsequently organises, so that eventually the tendons become glued to their sheaths and other adjacent structures, leading to a very serious limitation of function. Stiffness may result even when the fracture is some distance from the affected tendons. Thus after any fracture of the forearm there may be some pain and impaired movement of the fingers or wrist-joint. This may be due to prolonged immobilisation or depend upon some simultaneous injury of the muscles of the forearm.

(*d*) *Œdema.*—A painful swollen condition of the limb below the site of the injury is a not uncommon sequela of a fracture of the bones of the leg. It may persist indefinitely, and by interfering with the movements of the foot and ankle produce a serious disability. The swelling has the character of a solid œdema. It is probably caused by lymphatic obstruction and venous thrombosis resulting from the injury. The importance of normal muscular contraction in maintaining the flow of lymph is well known, and the absence of this owing to immobilisation, combined with the effect of gravity on the impaired circulation, is undoubtedly an important factor in its production.

Lucas Championnière has for many years emphasised the importance of massage and passive movements in preventing these sequelæ and in restoring the normal functions to the injured part. He, indeed, regards this as the method *par excellence* of treating practically all fractures, reduction and fixation of the fragments by means of splints being regarded as of secondary importance. In many cases he uses no splints or other apparatus for immobilisation, massage and passive movements being employed alone from the very first. According to Lucas Championnière, massage and passive movements have the following effects :

(*a*) The nutrition of the muscles is maintained. They do not atrophy, and contractions with the resulting deformities are prevented.

(*b*) The swelling due to the early effusion of blood soon disappears. Massage also promotes the absorption of later inflammatory exudations.

(*c*) As the result of the maintenance of function the circulation in all the constituents of the limb is improved. Painful œdema is thus less likely to occur.

(*d*) Stiffness and pain in the neighbouring joints and tendon sheaths soon disappear.

(*e*) The pain at the site of fracture is relieved. Great stress is laid upon the fact that the relief of pain brought about by immobilisation is often deceptive, for as soon as the splint is removed and movement started the pain is very likely to recur.

(*f*) Massage is said to aid the formation of callus and to diminish the time required for firm union. There is considerable doubt as to whether this really is the case, though inaccurate apposition and the occurrence of movement between the fragments certainly lead to increased production of callus. Lucas Championnière points out that delayed union and non-union may occur where there has been most thorough immobilisation by splints, and maintains that these untoward results are less likely to occur when massage and passive movements have been used from the first.

(*g*) Congestion, coldness and anæsthesia of the skin rapidly improve.

While thoroughly admitting the importance of massage, the majority of surgeons will prefer, except in certain cases where there is no displacement or where satisfactory fixation by apparatus is impossible, to regard this mode of treatment as an essential adjunct to the judicious use of splints.

Massage may be commenced shortly after the injury, or, if thought desirable, a few days may be allowed to elapse while the limb is kept at rest. Generally speaking, it may be said that early massage is indicated when the line of fracture implicates or is in close proximity to a joint. In many cases massage may be started at once, possibly without removal of the splint, while passive movements are started after an interval of seven to fourteen days.

When massage is started in the course of the first few days after the injury the bandages are removed, but the splint is allowed to remain in position. Gentle stroking movements (*effleurage*) are made towards the trunk over the muscles involved, both above and below the fracture, but it is best at first to avoid any pressure over the actual site of the injury. In cases of fracture of the bones of the forearm or of the leg it is as well to commence at the same time passive movements of the fingers or the toes.

The treatment should at first be carried out for about fifteen minutes, and should be repeated daily. About the end of the first week deeper movements of kneading and percussion may be commenced with advantage. Diminution of the pain and swelling usually quickly occurs, and owing to the diminution of muscular spasm the position of the fragments is often improved.

Passive movements should be commenced first in the joints at some distance from the fracture, *i.e.*, in a fracture near the knee-joint movement of the hip and ankle should be carried out for some days before the knee itself is disturbed.

When the line of fracture crosses or is close to the articular surface there is some controversy as to the best time for starting passive movements of the affected joint. Indeed, no absolute rule can be laid down. Each fracture must be treated according to its merits. Generally speaking, however, a period of rest of seven to fourteen days is desirable. In any case, the first movements must be very gentle, and the joint should only be moved once or twice in each direction. Generally, the splint need not be completely removed, and the greatest care must be taken to support the fracture.

In some cases, especially after prolonged immobilisation, adhesions in an adjacent joint may cause a serious limitation of movement. It may then be necessary to administer an anæsthetic and carry out forcible movements in the stiff joint. When the trouble is due to one or a few cord-like adhesions, this treatment may be successful, but too frequently, however, forcible movements are followed by increased swelling and pain. When this occurs the treatment should be discontinued, for any adhesions which have been broken down will probably again develop, and the trouble may even be increased.

When pain and stiffness in joints or tendon sheaths persist after a fracture, improvement may often be brought about by the use of hot-air baths. The affected limb or joint is enclosed in a case in which hot air circulates. This treatment should be carried out for about three-quarters of an hour daily.

GENERAL PRINCIPLES OF THE TREATMENT OF COMPOUND FRACTURES.

The chief danger of a compound fracture is septic infection. Suppuration is very likely to ensue, and the septic process can then readily extend to the fractured ends of the bone. A septic osteomyelitis terminating in necrosis may then be expected, while in some cases pyæmia or septicæmia may result. If septic infection could be entirely eliminated a compound fracture would not be much more serious than a simple fracture. It is thus obvious that the efforts of the surgeon must be chiefly directed towards rendering the wound aseptic. The skin wound may be of any size, from a small puncture produced by the sharp edge of one of the fragments, to a very extensive laceration caused by a direct crush at the time of the injury. Whatever its size, the edges of the wound are always contused and lacerated. It may be situated on a fairly clean portion of the skin protected by the clothing, while in some cases mud or other septic foreign substances may be seen to be ground into the crushed soft parts as well as into the fractured bones. In these cases there is a danger of infection with the tetanus bacillus or the bacillus of malignant œdema.

The treatment will depend upon the size and position of the wound. If it is small and is situated in a fairly clean portion of the skin it is possible that serious infection has not taken place. Under these circumstances the skin for some distance around is carefully shaved and cleansed before the wound is investigated. The opening is then enlarged and all blood clot is washed away with carbolic lotion. The wound is irrigated with hot saline solution and may be completely closed. It is always best in these cases to enlarge the skin wound, as otherwise the lotion may be forced by the syringe along the fascial planes. An antiseptic dressing is then applied, and the bones are manipulated into as good a position as possible, and the limb placed on a suitable splint. The dressing must be changed daily and a careful watch also kept on the temperature and pulse-rate. Pyrexia, redness or œdema will be indications for removing the stitches and draining the wound.

When the wound is large and extensive it must be opened up if necessary, and thoroughly washed out with carbolic lotion. If the fracture is comminuted, any loose fragments of bone should be removed. Crushed and lacerated portions of skin or of the deeper soft tissues are clipped away with scissors. When dirt is ground into the tissues it is useless to attempt to get it away by washing; it is necessary to cut these septic areas away. The edges of the skin may then be approximated by a few stitches, but in these severe and septic cases rubber tubes or strips of gauze must be used to drain the deeper parts of the wound. The bones are manipulated into position, and a suitable splint is applied to the injured limb. Bier's constricting bandage may be used in these cases as a prophylactic against sepsis.

Careful watch must be kept for the occurrence of suppuration, and further incisions may subsequently be necessary for the escape of pus. Should there be pyrexia associated with rigors, pyæmia or septicæmia may be suspected, and amputation, if possible through the joint or bone above the fracture, will then be called for. Other indications for secondary amputation which may appear within a short time of the injury are acute traumatic gangrene and moist gangrene of the distal portion of the limb. The former, which rapidly spreads from the wound towards the trunk, is the result of infection with a specific organism, the Bacillus ærogenes capsulatus. The latter form of gangrene depends upon injury of the main vessels of the limb. When suppuration occurs, necrosis is exceedingly likely to occur. The sequestrum takes a long time, often three or four months, to separate. It should, when loose, be removed; closure of the sinuses may then be expected. Extensive necrosis and serious interference with the soft parts by the prolonged suppuration may render secondary amputation necessary even some months after the injury.

The question frequently arises as to whether it is desirable to secure the fragments in position by means of plates, wire or screws. Generally speaking, it may be said that, unless the position is very bad, it is best to avoid direct fixation. The wound is always septic, and the disturbance of the parts involved in this operation, combined with the presence of a foreign body, may lead to severe and troublesome suppuration, resulting in extensive necrosis. If manipulation of the fragments when the patient is anæsthetised fails to secure moderately good apposition, direct fixation may be necessary. In such a case it is best to cleanse the wound as described above, and then to allow several days to elapse before undertaking this operation, so that the extent of the septic infection can be satisfactorily determined.

Primary amputation is occasionally necessary in bad cases of compound fracture. In severe crushes, such as result from railway accidents, when the limb is attached only by shreds of skin and soft parts, this treatment is obvious. It is also indicated when the main vessels of the limb are ruptured, or when a badly comminuted fracture is associated with extensive laceration of the soft parts. In doubtful cases, of course, an attempt should be made to save the limb, a careful watch being kept for the appearance of gangrene or for signs of septicæmia or pyæmia.

FRACTURES OF THE CLAVICLE.

A fracture of the clavicle is an exceedingly common injury. It may be produced by direct violence, such as a blow or fall on the shoulder, or by indirect violence, such as a fall on the hand.

As the whole extent of the bone is subcutaneous, the diagnosis is usually easy except in fractures of the acromial extremity.

Complications are very unusual. Injury to the adjacent large vessels has been recorded, and subclavian aneurysm has occasionally followed a fracture of the clavicle. Several cases have also been recorded where the brachial plexus was either injured at the time or subsequently involved in the callus.

A compound fracture of the clavicle is very rare.

Immediately after the injury the forearm may be supported in a sling until the patient reaches either his home or a hospital.

The shoulder is displaced downwards, forwards and inwards. This deformity must be corrected by manipulation, which is conveniently carried out in the following manner: The surgeon, standing behind the patient, places one hand in the axilla and with the other grasps the elbow. The shoulder is then drawn outwards, backwards, and at the same time is pushed upwards. Occasionally reduction may be brought about by drawing both shoulders backwards, the surgeon's knee being applied as a support between the patient's scapulæ.

Having got the fragments into good position, it is necessary to apply some apparatus to keep them in place. It must be admitted that this is not an easy matter. Fortunately firm union and a useful arm result even when the displacement and deformity are not completely corrected. The following are the methods usually employed:

(1) Where it is of importance that there shall be no deformity the patient, usually a female, must be kept in bed for three weeks. She must be recumbent and the head kept low by avoiding the use of a pillow.

The arm must be bandaged to the side and a firm pillow placed under the elbow of the injured side. Some surgeons, in addition, advise that a firm narrow pillow should be placed longitudinally between the scapulæ.

(2) An easily applied and satisfactory method is Sayres's strapping.

All that is required are two long pieces of adhesive plaster about 3 inches wide and a broad bandage. The extremity of one of these pieces of strapping is sewn loosely round the patient's arm just below the axilla, the non-adhesive surface being next to the patient's skin. The remainder of this length of strapping with the adhesive surface next to the skin is then drawn across the patient's back, round the opposite side of the chest, and ends in the axilla of the injured side. By this means the injured shoulder is drawn backwards, and the arm fixed to the side; the patient now flexes the forearm and places the hand of the injured side on the sound shoulder. A diamond-shaped cut is then made in the centre of the second piece of strapping. This is applied so that the olecranon projects through the aperture. One end of the strapping is then firmly drawn along the forearm to the sound shoulder, while the other extremity is drawn diagonally across the patient's back to reach the same spot. This tends to raise the injured shoulder. A small pad of absorbent wool well sprinkled with boracic powder may with advantage be placed in the axilla to diminish the unpleasant effects of perspiration.

For such a pad to have any effect in remedying the inward displacement of the shoulder it would have to be of such a size and consistence as to threaten serious danger from pressure on the axillary vessels. When the strapping is satisfactorily in position a broad bandage is placed round the chest and over the sound shoulder.

Fixation is necessary for about three weeks. The forearm should be supported in a sling for another week, rubbing and passive movements being carried out daily.

(3) In those cases where the displacement is but slight, especially in a fracture of the outer extremity, any elaborate retentive apparatus is obviously undesirable. All that is necessary in these cases is that the forearm should be supported by a sling, massage of the surrounding muscles being started at once and repeated daily.

Even when there is considerable displacement this treatment may be chosen. Lucas Championnière insists that the displacement of the fragments is maintained by the contraction of the neighbouring muscles, and that no retentive apparatus can possibly overcome this contraction. Daily massage relieves pain, and by diminishing the contraction of the muscles improves the position. In the intervals the forearm is supported in a sling, and the arm is bound to the side. After the lapse of a few days movements of circumduction are carried out, followed by movements of abduction and elevation of the arm and shoulder.

FRACTURES OF THE SCAPULA.

Fractures of the scapula are distinctly rare, a marked contrast to fractures of the clavicle. This is probably owing to its mobility. Nearly always the fracture is the result of considerable direct violence. Very rarely muscular action may be the cause, as in some cases of fracture of the coracoid process and even of the inferior angle.

(1) **Fracture of the Body.**—This is usually caused by direct violence applied to the spine of the scapula. Occasionally there may be a single line of fracture traversing the supra-spinous fossa or separating the inferior angle. Usually the fracture is comminuted, and far more commonly is situated below the level of the spine.

Any marked displacement must be corrected by direct manipulation of the fragments and also by manipulations of the shoulder-joint. It will now be necessary to limit the movement of the bone as far as possible while union is taking place.

This is best done in the following manner: A double layer of lint is placed over the bone and secured in position by several pieces of strapping 2 inches broad, of such a length as to extend half-way round the thorax. A thin pad of absorbent wool well dusted with boracic powder is placed in the axilla, and the arm is bound to the chest by a broad bandage. The forearm is supported in a sling. At the end of a week the bandage and strapping are removed for massage and passive movements of the shoulder.

This treatment should be repeated on alternate days, the arm being fixed to the chest and the forearm being supported in a sling in the intervals.

(2) **Fractures of the Neck.**—Under this heading may be considered: (*a*) Fractures of the glenoid cavity. Small fragments may be chipped from the margin of the glenoid cavity. These fragments are very seldom recognised during life, since they usually are associated with dislocations of the shoulder-joint. The treatment is essentially that of the accompanying dislocation. Owing to the presence of the fracture there will probably be a tendency for the dislocation to recur if active movement is permitted before union has taken place.

(*b*) Fractures of the anatomical or of the surgical neck. Both these, especially the latter, are exceedingly rare injuries; a fracture of the head or the neck of the humerus may also be present. The fracture usually extends from the supra-scapular notch to the axillary border, so that the whole of the coracoid process is attached to the outer fragment. This injury usually results from a direct blow to the shoulder.

The elbow is supported by a broad piece of strapping, one end of which passes upwards in front of the shoulder and is fixed over the outer third of the clavicle. The other end is drawn upwards in a similar fashion over the back of the joint and fixed in a similar position. The arm is then bandaged to the side, and additional support to the elbow secured by several turns of the bandage passing under the elbow and diagonally across the chest to pass over the sound shoulder.

Should it be impossible to satisfactorily reduce the deformity or to prevent its recurrence, operative treatment would be necessary.

(3) **Fracture of the Acromion Process.** — This is usually caused by direct violence, such as a fall or a blow on the shoulder. Occasionally it may result from indirect violence, such as a fall on the elbow.

Any displacement should be corrected by raising the elbow, and thus pressing the head of the humerus against the acromion. It is difficult to maintain the fragments in position, but this is best done by binding the arm to the side and raising the elbow, as in Sayres's method of treating fracture of the clavicle. Fixation should be maintained for about three weeks, and should be followed by massage and passive movements.

Fibrous union usually results, but this and the persistence of a certain amount of deformity do not interfere with the function of the part.

(4) **Fracture of the Coracoid Process.**—This rare injury is usually brought about by direct violence, but is occasionally the result of muscular action.

The tip of the process may alone be separated, or a line of fracture may cross the base of the process to top of the glenoid cavity. Separation of the epiphysis may also occur.

The arm should be bandaged to the side and the forearm supported in a sling. Massage and passive movements should be commenced early. Union will probably be fibrous.

FRACTURES OF THE HUMERUS.

Fracture of the humerus is not a very frequent injury, but many varieties are recognised. They may be classified in three groups:

(1) Fractures of the upper extremity; (2) fractures of the shaft; (3) fractures of the lower extremity.

(1) **Fractures of the Upper Extremity.**—This group includes: (*a*) Fractures of the anatomical neck; (*b*) fractures of the tuberosities; (*c*) fractures of the surgical neck; (*d*) separation of the epiphysis.

The most important anatomical characters of all this group of fractures are: (i.) their proximity to the shoulder-joint; (ii.) the small size of the upper fragment, which is thickly covered by soft structure.

Etiology.—These fractures are usually the result of considerable direct violence. Fracture of the surgical neck may, however, be caused by indirect violence, such as a fall on the hand or elbow, and cases have been recorded where the great tuberosity has been detached as the result of muscular action.

Complications.—These fractures are frequently impacted or comminuted. Dislocation of the shoulder-joint may also co-exist. Occasionally the axillary vessels, or branches of the brachial plexus, especially of the circumflex nerve, may be injured.

The small size of the upper fragment is an important factor in the treatment of all fractures of the upper extremity of the humerus. It is also thickly covered by muscles, and thus it is very difficult to control its position and movements by means of splints. Owing to the proximity of the fracture to the shoulder-joint there is a great tendency to stiffness, which must be combated by careful massage and graduated passive movements.

(*a*) **Fractures of the Anatomical Neck.**—The diagnosis of this rare injury will be made or confirmed by skiagraphic examination. The head may be completely detached. More usually it remains connected with the shaft by shreds of periosteum or a strip of the capsule.

The treatment will depend upon the displacement and the possibility of manipulating the small upper fragment into good position. If the position is good an impacted fracture should not be broken down.

(i.) *There is but slight displacement, or the displacement can be reduced by manipulation.*—In this case the important point is to secure a movable joint. The arm must be kept to the side, the forearm supported by a sling, and a moulded splint made to support and protect the shoulder. The latter should extend from the neck to within a short distance of the elbow. It may be constructed of leather, poroplastic, or guttapercha.

To ensure a good fit, a paper pattern should first be cut out from actual measurement. This will consist of a central axis, with three wing-shaped projections on each side (*see* Fig. 4). The central axial portion, about 3 inches wide, rests against the outer side of the arm and the top of the shoulder; the upper wing-shaped piece covers the clavicular region in front and the supra-scapular region behind; the middle wings extend across the chest and back respectively to well beyond the mid-line, while the lowest portions encircle the arm. The paper pattern is then laid on a sheet of the material to be used and the splint is cut out. A leather splint is softened by immersion in vinegar, poroplastic or guttapercha by soaking in hot water. The material thus cut out is then moulded to the limb and fixed in position by a bandage, care being taken in the case of the latter two substances that the heat is not sufficient to scald the skin.

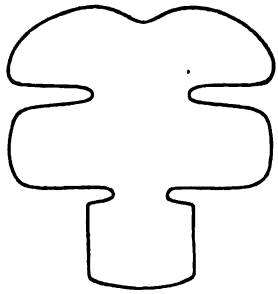


FIG. 4.—Sheet of poroplastic cut for a moulded shoulder cap.

When the splint has hardened in position it is removed, and if leather or guttapercha is used, a few small holes are punched to allow the escape of perspiration. Tapes and buckles are then attached. Such a splint can be easily removed for massage, which may begin the day after the injury, gentle passive movements being commenced on the tenth day.

(ii.) *There is considerable displacement which cannot be overcome by manipulation.*—Owing to the small size of the head this is not infrequently the case. Cases have even been recorded where the head has been completely turned round, so that the articular surface of the head rests against the fractured neck and the fractured surface of the head rests against the glenoid cavity. In these cases operative interference is certainly indicated if a movable joint is to result. If the head is still attached by periosteum or capsule to the lower fragment it may be replaced and fixed in position. If it is free in the cavity of the joint it may be removed.

(*b*) **Fractures of the Tuberosities.**—Fracture of either tuberosity alone is a rare accident. A fracture of the greater tuberosity usually is present as a complication of some other injury, such as dislocation of the shoulder or comminuted fracture of the surgical neck. Fractures of the surgical neck in which the line of fracture traverses the great tuberosity are, however, by no means uncommon. In this case the treatment will be that of fracture of the surgical neck (*q.v.*).

When the great tuberosity alone is separated the patient should be kept in bed for three weeks with the arm abducted and externally rotated, the limb being maintained in this position for the three weeks, massage being commenced early, about the third day.

This treatment is very tedious, and union in a bad position is likely to be followed by diminished power of abduction.

It is thus advisable in most cases to expose the fracture by an open incision and fix the separated fragment in position by a plate or screw.

(*c*) **Fracture of the Surgical Neck.**—Under this heading are included fractures through the tuberosities and also of the shaft immediately below them.

Not infrequently these fractures are comminuted. The upper fragment is usually abducted and the lower fragment displaced upwards and to its inner side. Reduction is effected by manipulation and extension, the latter being applied while the arm is abducted owing to the usual displacement of the upper fragment.

An anæsthetic may be necessary. The further treatment will depend upon the tendency of the displacement to recur.

(i.) *When the fracture is transverse.*—In this case the arm may be brought down to the side with but little tendency for the deformity to re-appear. Under these circumstances a shoulder cap may be made as described above, the arm bandaged to the side and the wrist supported in a sling.

The support should not extend to the elbow, as the weight of the arm produces extension. This effect may be increased by the application of a stirrup to which a weight of 2 lb. or 3 lb. is attached. The apparatus should be removed for daily massage on the fifth day. Union occurs in about six weeks.

(ii.) *If reduction is unsatisfactory, or if the displacement easily recurs.*—Under these circumstances continuous extension by means of a weight and pulley may be tried. The patient is kept in bed with the injured arm comfortably supported on a pillow in the abducted position. A stirrup apparatus is then fixed to the arm, the adhesive strapping of which extends from the region of the fracture to just above the wrist.

The cord of the stirrup passes over a pulley, which is attached to the side of the bed, and supports a weight of about 4 lb.

Counter-extension may be maintained by means of a broad band passing round the patient's body and attached to the opposite side of the bed. This position may be maintained for two weeks, when a shoulder-cap may be constructed and daily massage commenced.

Another useful means of treating fractures of the surgical neck is by means of Middledorf's triangle, a description of which with its mode of application is given in the treatment of fractures of the shaft.

In all cases the position of the fragments should be investigated by means of a radiographic examination after reduction, and if the position is not satisfactory the fractured ends should be cut down on and fixed in position by a plate or screw.

(*d*) **Separation of the Upper Epiphysis.**—The upper epiphysis of the humerus includes the head and the greater part of the tuberosities. The inner half of the epiphysial line corresponds to the anatomical neck and slopes upwards, the outer half slopes downwards through the tuberosities.

The epiphysis is thus concave on its inferior surface. The humerus grows in length chiefly from this epiphysis, and hence injury may be followed by an arrest of growth. The separated epiphysis remains connected with the shaft by a broad band of periosteum, usually on its posterior aspect. The shaft is usually displaced upwards and inwards, and the epiphysis is in an abducted position. Reduction may usually be effected by traction and direct manipulation of the upper end of the shaft under an anæsthetic. A shoulder-cap is then applied, and the arm kept at rest for about four weeks. Massage must be commenced about the fifth day.

Occasionally satisfactory reduction may be impossible owing chiefly to the interposition of the torn periosteum. Under these circumstances an open operation with mechanical fixation is necessary.

(2) **Fractures of the Shaft.**—The shaft of the humerus may be fractured in any part of its extent, but the commonest site is just below the attachment of the deltoid. The injury may be caused by direct violence applied to the arm, by indirect violence, such as a fall on the hand, or may sometimes be the result of muscular action.

The musculo-spiral nerve is liable to be injured, since it is in close relation to the bone in its course along the musculo-spiral groove. The nerve may be torn by a sharp edge of bone at the time of the injury, but more usually the resulting paralysis of the extensors of the forearm appears later on as the result of gradual implication in the callus.

A not uncommon late complication is non-union or the formation of a false joint. This is probably due to inadequate fixation permitting movement between the fragments.

Reduction may be effected by applying extension from the condyles, the elbow being flexed. Fixation of the fracture is a matter of considerable difficulty. The following methods may be used:

(*a*) If the displacement shows a tendency to recur, extension for two weeks by the weight and pulley may be tried, as described above in the treatment of a fracture through the surgical neck.

(*b*) By internal angular and short splints. A well-padded internal angular splint is chosen, and is firmly bandaged to the forearm. Extension is then applied from the elbow, and is maintained while the splint is secured in position to the inner surface of the arm. Three small well-padded splints of sufficient length to reach from the level of the anterior fold of the axilla to just above the condyles are then placed against the arm on its anterior, external and posterior aspects, and are secured in position by two strips of adhesive strapping, encircling also the vertical limb of the internal angular splint.

Instead of the small splints a piece of Gooch's splinting may be used. In either case a bandage is applied to secure the splints in position, and the forearm is supported in a sling.

The objections to this method are: (i.) The upper fragment is so small that it is very imperfectly controlled by the splints; (ii.) movement is permitted at the shoulder-joint; (iii.) the lower fragment is likely to be internally rotated.

The forearm should not be drawn across the chest, but should be allowed to project forwards, as in the former position there is probability of internal rotation of the lower fragment.

(*c*) Middledorf's Triangle may be used, especially when the upper fragment is in an abducted position. This apparatus consists of three well-padded splints fitted together so as to form an obtuse-angled isosceles triangle. The long side of the triangle rests against the side of the body, and extends from the axilla to the pelvis. The arm and forearm rest against the two shorter sides, and the obtuse angle fits into the elbow.

The instrument is fixed in position by broad bands passing round the chest and pelvis, and by tapes and buckles across the shoulder. Before the arm and forearm are fixed to the splint by adhesive strapping and bandages a piece of Gooch's splinting may with advantage be placed against the outer aspect of the arm.

The chief objection to Middledorf's triangle is that the arm is of necessity fixed in a position of internal rotation, and hence the axis of the lower fragment may not correspond with that of the upper. The splint should be worn for about a month.

If the fracture is oblique satisfactory reduction and fixation may be impossible. Under these circumstances operation for the purpose of plating or screwing the fragments will be necessary.

Injury to the musculo-spiral Nerve.—This is essentially operative. Should the symptoms of injury to the nerve immediately follow the accident, the probability is that it has been torn by a sharp edge of bone.

It should certainly be cut down on within a few days and its condition investigated. If completely torn across it should be sutured. If the paralysis comes on gradually after an interval of some days or weeks the nerve is probably involved in callus. An operation will be required to free it (*see* Injuries of Nerves).

(3) **Fractures of the Lower Extremity.**—Fractures of the lower extremity of the humerus present numerous difficulties both as regards diagnosis and treatment.

The line of fracture very frequently crosses the articular surface of the humerus, and hence these injuries are likely to be followed by stiffness of the elbow-joint. Even when the joint is not injured serious limitation of movement may result from an excess of callus in the position of the olecranon coronoid and radial fossæ. Occasionally there may be a co-existing dislocation of the elbow, or the fracture may be comminuted. In all cases the small size of the lower fragment is a serious difficulty in the reduction of the fracture.

Diagnosis is often a matter of great difficulty, and in every case where a fracture in the region of the elbow is suspected a radiographic examination should be made. A second examination should also be always carried out a few days after treatment has been started to make sure that the position of the fragments is satisfactory.

The character of fractures in this region varies considerably, but the following main groups may be distinguished :

(*a*) Supra-condyloid fracture. The line of fracture is more or less transverse. The lower fragment is displaced upwards and backwards behind the upper fragment. The deformity resembles that of a backward dislocation of the elbow, from which it may be diagnosed by a radiographic examination and by the presence of shortening, measurements being taken from the tip of the acromion to the external condyle.

(*b*) Fracture of the external condyle. The line of fracture extends from the base of the external condyle across the articular surface, separating the capitellum and possibly also part of the trochlea.

(*c*) Fracture of the internal condyle. The line of fracture crosses the base of the internal condyle and also involves the joint traversing the trochlea.

Occasionally the tip of the internal condyle alone is fractured, the joint remaining uninjured. This variety may be termed "fracture of the epicondyle."

(*d*) T-shaped fracture. This is really a combination of the above three varieties. There is a transverse fracture above the condyles and a vertical fracture traversing some part of the articular surface. The joint is of necessity injured.

(*e*) Fracture of the articular surface. The usual variety is a fracture of the capitellum. Separation of the trochlea alone is rare.

(*f*) Separation of the lower epiphysis. The signs and symptoms of this injury closely resemble those of supra-condyloid fracture. The line of separation may pass above or below the internal condyle, the latter being usual in infancy and the former the more common after the age of twelve years. The line of separation, however, frequently leaves the epiphysial line and extends into the adjacent portion of the shaft. As in the case of supra-condyloid fracture, the appearance closely resembles that of backward dislocation of the elbow, from which it may be diagnosed by the age of the patient and by shortening of the distance from the acromion to the external condyle.

In all these injuries there is a danger of serious impairment of the movement of the elbow-joint.

Massage and gentle passive movements must therefore be commenced early, and must be persevered with for some weeks. In the treatment of fractures in the neighbourhood of the elbow-joint it must be borne in mind that the axis of the forearm is not in the same line as the axis of the arm, but is inclined slightly outwards from it, so that if the axis of the arm were continued downwards it would make an angle of about 15 degrees with the axis of the forearm.

Interference with this "carrying angle" is likely to result in impaired function of the elbow-joint.

(*a*) *Supra-condyloid Fracture.*—For the satisfactory reduction of this fracture an anæsthetic is required.

The forearm is fully flexed and extension is made with one hand while the lower fragment is pressed into position with the other.

The fragments may usually be got into good position in this way, but owing to the obliquity of the fracture there is a great tendency for recurrence of the displacement. The following methods of fixation may be used:

(i.) An internal angular splint for the arm and forearm.

This is not of much use, as there is nothing to prevent the occurrence of the antero-posterior displacement.

(ii.) A better method is to use an anterior angular splint, which must be well padded, combined with a posterior splint for the arm, extending down to just beyond the olecranon process.

The effect of this will be to force the olecranon, and with it the lower fragment, forwards. It must be remembered that with an anterior angular splint there is a danger of the circulation of the limb being seriously obstructed, so that a careful watch must be kept on the patient's fingers.

(iii.) When the fracture has been reduced, good position may be maintained by keeping the elbow-joint as fully flexed as possible with the forearm completely supinated.

The limb may be maintained in this position by either a moulded gutta percha splint or by trough splints for the arm and forearm, joined together by an iron bar which is bent to the requisite angle opposite the olecranon.

This position may also be maintained by bandaging the wrist to the upper part of the arm, over a layer of absorbent wool. The whole limb should then be secured to the side by a broad bandage. The fingers must be carefully watched for signs of obstructed circulation.

(iv.) Direct fixation of the fragments after an incision exposing the fracture may be the only method of securing a good position.

Though the fracture is usually well above the joint there is a strong probability of callus invading the olecranon, coronoid, and radial fossae, and thus causing limitation of movement.

Massage and cautious passive movements must, therefore, be started by the fifth day, the splint being subsequently removed on alternate days for continuance of this treatment.

(*b*) *Fracture of the External Condyle.*—The joint is here necessarily involved. The treatment may be non-operative or operative. In the former case an anæsthetic must be given, the fragment manipulated into position, and an internal angular or posterior angular splint applied. Massage and passive movement should be commenced on the third day. Operative treatment will enable the fragments to be fixed in good position, and thus give a better chance of a movable joint.

(*c*) *Fracture of the Internal Condyle.*—As in the case of the external condyle, the joint is involved. The fragment is too small usually to be manipulated or to be controlled satisfactorily by a splint. Radiographic examination should be made to ascertain the exact position. Displacement is usually not great. An internal angular splint may be applied to keep the joint at rest, and massage may be started at once.

It is with this fracture especially that a certain amount of displacement upwards may cause an alteration of the carrying angle, producing an adduction of the forearm known as "Cubitus varus." If any very marked deformity is present, operative treatment gives the best prospect of securing good position.

If the small epicondyle alone is detached, an accident especially likely to occur in children, the joint is uninjured. The small fragment is drawn slightly downwards by the flexor muscles.

The only treatment necessary is to apply a pad and an internal angular splint. Passive movements of the joint should be carried out after the lapse of a few days. In children fixation of the elbow in the fully flexed position is easily carried out, and gives good results.

(*d*) T-*shaped Fracture.*—With these fractures, usually caused by great direct violence and frequently comminuted, there is a strong probability of a serious diminution of movement at the elbow-joint. Care must be taken that if ankylosis does occur that it takes place with the forearm flexed to a right angle and half-way between full pronation and full supination. Ankylosis in this position causes the minimum of subsequent disability.

The fracture is reduced as far as possible while the patient is anæsthetised. It may then be treated as described for supra-condyloid fracture by an anterior angular splint, combined with a posterior splint for the arm extending to just below the olecranon. The fully flexed position also often gives good results. Massage should be started on the third day, but however thoroughly it is carried out serious limitation of movement is likely to result. In certain cases immediate operative treatment is desirable to fix the fragments in position.

In other cases where ankylosis results, especially in a bad position, a more useful limb may be obtained by excision of the joint.

(*e*) *Fracture of the Capitellum.*—In these rare fractures any manipulation of the separated fragment is impossible owing to its small size. The treatment is thus operative, the small fragment being usually removed.

(*f*) *Separation of the Lower Epiphysis.*—The epiphysis must be replaced by manipulation, the patient being anæsthetised.

The displacement is similar to that of a supra-condyloid fracture, and its recurrence is best prevented by the use of an anterior angular splint, with a posterior splint for the arm.

In small children, however, the most satisfactory method is to fix the forearm, after reduction of the displacement, in a position of complete flexion with the hand over the shoulder of the injured side. The arm may be secured in this position by a bandage, and the whole limb should be bandaged to the side of the chest. Passive movements should be commenced on the tenth day.

FRACTURES OF THE BONES OF THE FOREARM.

Fractures of the radius and the ulna are very common. Either may be fractured alone, but frequently both are broken at the same time, for which reason it is more convenient to consider fractures of the bones of the forearm together under the following headings: (1) Fractures in the region of the elbow-joint; (2) Fractures of the shaft of the radius and the ulna; (3) Fractures in the region of the wrist-joint.

(1) Fractures in the Region of the Elbow-joint.—The importance of these injuries, as in the case of fractures of other bones near joints, depends upon the likelihood of serious limitation of movement resulting from the injury. In the elbow-joint especially, ankylosis in a bad position may seriously cripple the movement of the forearm.

The synovial cavity of the elbow is continuous with the superior radio-ulnar joint, and hence in addition to stiffness of the elbow-joint proper there is a possibility of serious diminution or even total loss of the power of pronation and supination.

The injuries, too, in this region are often very complex.

Thus the articular surfaces of both bones may be fractured. Not infrequently there is also dislocation of one or both of the bones of the forearm from the humerus, and the latter bone may also be fractured.

The following fractures are included under this heading: (*a*) Fracture of the olecranon; (*b*) Fracture of the coronoid process; (*c*) Fractures of the head of the radius; (*d*) Separation of the upper epiphysis of the radius.

(*a*) *Fracture of the Olecranon.*—This injury is usually the result of a fall on the point of the elbow. Rarely it is caused by muscular action alone, but probably even when direct violence appears to be the cause, violent contraction of the triceps also plays an important part.

The line of fracture usually traverses the process near its constricted base, so that the separated fragment is of considerable size.

Occasionally, however, the tip of the process alone is detached.

The displacement is often considerable, the triceps drawing the separated portion upwards and leaving a gap in the continuity of the bone readily recognisable on palpation. This is, however, by no means always the case. If the lateral expansions of the tendon of the triceps which pass to the deep fascia remain untorn, the separation may be slight, and may be easily overlooked at an ordinary examination. The routine skiagraphic examination will then reveal the nature of the injury.

Fracture of the olecranon may be complicated by: (i.) Co-existent fracture of the radius; (ii.) Dislocation forwards of the ulna, or of the radius and ulna, from the humerus; (iii.) Injury to the ulnar nerve.

Most cases of fracture of the olecranon are best treated by operative measures, but as this section deals primarily with the non-operative treatment of fractures, the latter will be considered first. The chief points to be discussed are: (*a*) Whether the forearm shall be fixed in an extended position by a long anterior splint, or in a flexed position by anterior or internal angular splints; (*b*) Whether any method can be adopted to draw downwards the displaced upper fragment.

With regard to the first question, it is pointed out that the extended position relaxes the triceps, and so favours approximation of the fragments, while should ankylosis result the flexed position is by far the more convenient for the patient.

The flexed position is the more comfortable, and it may be here urged that the forearm should never be fixed in a position of full extension, but that a small pad of wool should be placed opposite the bend of the elbow to maintain slight flexion.

Various methods have been adopted to produce approximation of the fragments. The usual method is to place a small pad above the upper fragment, and by means of a figure of 8 bandage crossing in front of the elbow to endeavour to draw it downward. A ∩-shaped piece of strapping may also be tried, the loop of the ∩ passing above the olecranon, and the limbs fixed to the lateral borders of the forearm. An apparatus similar to Malgaigne's hooks for the patella has also been used; but if the separation is so serious that the simpler means are not effective, it will probably be best to open the joint and wire the fracture.

Since the injury necessarily involves the joint there will certainly be considerable swelling from the effusion of blood. This may be treated for a few days by the application of an ice-bag or of evaporating lotion.

The extended position should be chosen when there is considerable displacement. A well-padded straight splint reaching from the anterior fold of the axilla to the heads of the metacarpals is fixed to the anterior aspect of the arm and forearm, a pad of wool being placed in front of the elbow to maintain slight flexion.

The posterior surface of the joint is left uncovered for the application of evaporating lotion. After three or four days this may be omitted, and the pad or strapping fixed in position to approximate the fragments. Massage and gentle passive movements may be commenced about the tenth day. The patient should be instructed to move his fingers freely from the first.

The flexed position will be chosen when separation is only slight. An anterior angular splint should be used, the posterior aspect of elbow being exposed for the treatment of the swelling. Massage and passive movements should be started after seven days.

If the patient is young and healthy, and especially if engaged in manual labour, operative treatment gives the best prospect of a strong and useful joint. If treated by splints, fibrous union will probably occur with some deficiency in the power of extension, even if the apposition of the fragments is good. This may be due to the interposition of torn shreds of fascia between the fractured surfaces. If operative treatment is carried out the joint is opened, blood clots washed away, shreds of fascia are removed, and the fragments fixed in position. It must be remembered, however, that limitation of movement and even ankylosis may occur even after operation. Operative treatment may also be called for in old cases with long fibrous union, originally treated by splints.

(*b*) *Fracture of the Coronoid Process.*—This fracture is nearly always associated with a backward dislocation of the ulna, it is very rarely the result of muscular action. The separated fragment is so small and is so deeply placed that it can rarely be felt, but when it complicates dislocation of the ulna, reduction is usually very easily effected and also very readily recurs. Under these circumstances the treatment will be that for dislocation of the elbow, passive movements and massage being started on the third day. The union may be fibrous or bony. Should the process be broken without any other injury, the forearm may be flexed to beyond the right angle to relax the brachialis anticus.

(*c*) *Fracture of the Head of the Radius.*—This may be caused either by direct violence or the result from a fall on the hand. It is not infrequently associated with some other injury, such as fracture of the capitellum or external condyle or dislocation of the elbow. The whole head may be separated, or only a portion of it chipped away. In many cases the diagnosis is made only after a radiographic examination.

The arm and forearm may be placed on an internal angular splint, or the forearm may simply be supported in a sling.

Massage and passive movements should be commenced at once.

If a portion of the head is separated so as to form a loose body in the joint or is markedly displaced, it should certainly be excised. Excision of the head of the radius for limited movement owing to excess of callus may be required in some cases.

The neck of the radius, *i.e.*, that portion of the bone between the orbicular ligament and the bicipital tuberosity, is occasionally fractured. Owing to the action of the biceps the lower fragment is supinated and drawn forwards. Occasionally the upper end of this fragment can be felt as a projection in front of the arm.

On pronating and supinating the patient's hand, with the fingers of the other hand fixing the head of the radius, this portion of the bone will be found not to rotate with the lower fragment, and crepitus may be felt. The treatment will be to keep the forearm at rest on a posterior angular splint.

(*d*) *Separation of the Upper Epiphyses.*—Separation of the small scale-like upper epiphysis of the ulna is exceedingly rare. Separation of the upper epiphysis of the radius may result from a wrench or fall on the hand. It should be treated by an anterior angular splint, massage and passive movements being commenced on the seventh day.

(2) **Fractures of the Shaft of the Radius and Ulna.**—The shaft of either the radius or the ulna may be fractured alone, or both bones of the forearm may be fractured together. In the latter case the radius is usually broken at a higher level than the ulna. These fractures may be caused by great direct violence, as is usually the case when the ulna alone is fractured, or by indirect violence, such as a fall on the hand.

Though situated at some distance from both the wrist and the elbow joints, serious limitation of the movements of pronation and supination may result, especially when both bones are fractured.

This may depend upon excessive formation of callus, so that the crossing over of the bone in pronation is a mechanical impossibility, or even to the actual junction of the callus of the two fractures, so that the bones become connected by a transverse osseous bar.

The forearm, too, is the commonest situation for the appearance of the ischæmic contracture of Volkmann, so that the greatest care must be taken to avoid tight bandaging in the application of splints. Great care must also be always taken to leave the fingers free, and the patient must be encouraged from the first to move them himself; otherwise a troublesome stiffness, owing to effusion into the tendon sheaths, may result.

(*a*) *Fracture of the Shaft of the Ulna alone.*—When the shaft of the ulna is fractured alone the unbroken radius prevents any over-riding of the fragments.

The fracture may be reduced by manipulation of the fragments, for which purpose an anæsthetic may be necessary.

The arm and forearm should then be fixed to an internal angular splint, so that the forearm is flexed to a right angle and in a position midway between full pronation and full supination.

The splint should extend as far as the heads of the metacarpals only, so that free movement of the fingers is permitted.

Fracture of the shaft of the ulna may be associated with dislocation of the head of the radius, usually in a forward direction.

When this condition is present an anæsthetic should be given, when the dislocation may be readily reduced, and the fracture at the same time be manipulated into position.

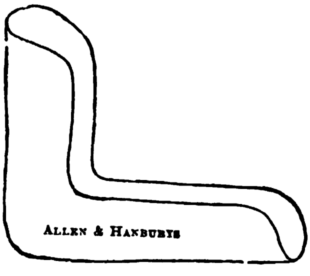


FIG. 5.—Posterior moulded splint for the elbow.

As the displacement of the radius is the more serious injury it is best to use an anterior angular splint, and to commence passive movements at the elbow-joint and also of pronation at the end of a week. Union of a fractured ulna may be expected in three or four weeks.

(*b*) *Fracture of the Shaft of the Radius alone.*—Here also the unbroken ulna prevents shortening or overlapping of the fragments. The displacement depends upon the site of the fracture. If above the insertion of the pronator radii teres the two chief supinators, the biceps and supinator brevis, are attached to the upper fragment and the two chief pronators, the pronator radii teres and the pronator quadratus, to the lower fragment. The upper fragment thus tends to become fully supinated and the lower fully pronated.

If the fracture is below the insertion of the pronator radii teres the upper fragment will be in a position midway between pronation and supination, and the lower fragment more fully pronated.

If the fracture is above the insertion of the pronator radii teres the forearm must, after the fracture has been reduced, be put up in a position of full supination with the elbow flexed to a right angle. This is best done by means of a well-padded anterior angular splint, with an additional pad to press backwards the prominent upper fragment. A posterior splint extending from the elbow to the wrist should also be used.

A posterior moulded splint of leather or poroplastic (*see* Fig. 5) will also give good results.

If the fracture is below the insertion of the pronator radii teres the elbow should be flexed to a right angle, and the forearm fixed in the semi-pronated position. This may be effected by using an internal angular splint. A posterior splint extending from the elbow to the back of the wrist should also be used.

As in the case of fracture of the ulna the patient must be encouraged to use his fingers, and in all these fractures passive movements of the elbow and wrist joints and also of pronation should be commenced on the tenth to fourteenth day.

(*c*) *Fracture of the Shafts of the Radius and Ulna.*—When both the bones of the forearm are fractured there may be considerable deformity and displacement.

The special dangers to be guarded against in the treatment of this fracture are cross-union and non-union. The former is said to be especially likely to result when there has been much laceration of the interosseous membrane. The most important means of preventing it is to avoid lateral compression of the bones by tight bandaging. Splints should be applied to the flexor and extensor aspects of the forearm and should extend slightly beyond the borders of the limb. Strapping or bandages to secure the splints in position will not then approximate to the bones.

A pad in the longitudinal axis of the limb to separate the bones is useless. Non-union occasionally results in a false joint being formed. It probably depends upon the elbow being imperfectly fixed, so that light movements of this joint and also some pronation and supination are allowed. A pseudarthrosis may be avoided by attending to these points. A bandage should never be applied beneath the splints, and the possibility of interfering with the circulation by constriction, and thus producing either Volkmann's contraction or gangrene, should always be borne in mind.

The fracture should be reduced, after an anæsthetic has been administered, by combined extension and manipulation of the fragments.

The question now arises as to the position in which the forearm should be fixed. In full supination the bones are widely separated, but the mid-position between pronation and supination is more comfortable for the patient, and may in most cases be chosen. A well-padded internal angular splint is placed on the inner aspect of the arm and forearm, and a posterior splint along the extensor surface of the forearm. These splints, which are slightly wider than the diameter of the limb, are fixed in position with adhesive strapping and bandages, and the forearm is supported in a sling. If the fracture of the radius is above the insertion of the pronator radii teres, or if there is a tendency for the four fractured ends to be drawn together, as may happen when the fractures are at the same level, the fully supinated position may be chosen. In this case an anterior angular splint for the arm and forearm, and a posterior splint for the forearm, will be selected.

In all cases the fingers should be carefully watched for any sign of obstructed circulation. A radiographic examination to make sure that the fragments are in good position is always desirable.

Owing to the danger of non-union passive movements should not be carried out until the third week. At least six weeks should elapse before the patient is allowed to freely use the arm.

(3) **Fractures in the Neighbourhood of the Wrist-joint.**—Under this heading are included the following fractures: (*a*) Colles's fracture; (*b*) Fracture of the styloid process of the ulna; (*c*) Separated lower epiphysis of the radius. These fractures are of the greatest importance owing to the probability of stiffness of the fingers and wrist-joint, which may be so marked as to completely cripple the hand.

(*a*) *Colles's Fracture.*—This is an exceedingly common injury, the fracture involving the lower extremity of the radius. It is always caused by a fall, the impact being received on the thenar eminence with the hand fully pronated. Though it may occur at any age, it is commoner in elderly people, especially women. The line of fracture is usually transverse from side to side, but when traced in the antero-posterior direction extends from the posterior surface of the radius downwards and forwards, so that it is nearer to the wrist-joint on the anterior aspect of the bone.

Very commonly it is impacted, the lower end of the upper fragment being driven into the cancellous tissue of the lower extremity of the bone. As a result of this the lower fragment is not infrequently comminuted.

In the treatment of Colles's fracture complete reduction is of the greatest importance. An anæsthetic is usually required and the fragments are then brought into position by extension of the hand and direct manipulation of the fragments.

Counter-extension from the elbow should be kept up by an assistant. Owing to the impaction considerable manipulation may be required, but when once reduced there is but little tendency for the deformity to recur.

A well-padded long anterior splint, slightly wider than the fore-arm and extending from the elbow to just above the heads of the metacarpals, should be used. It is of the greatest importance that the patient should be able to flex his fingers easily over the end of the splint. A small posterior splint, extending from the middle of the metacarpals to the upper part of the forearm, should also be used. These splints are firmly but not too tightly fixed, and the patient is instructed to move his fingers freely from the first.

On the third day the splints are removed and the wrist is gently flexed and extended, and the fingers are moved by the surgeon. This is repeated daily. Massage of the muscles of the forearm is commenced on the seventh day, when a light anterior splint alone should be used, the forearm being supported in a sling. Firm union occurs in about four weeks.

Certain special splints have been used for the treatment of this fracture, but they act on the erroneous theory that the displacement can be reduced by adduction or flexion at the wrist-joint. Of these splints Carr's alone is in general use at the present time. The lower end of this splint ends obliquely in a rounded bar, which when grasped by the fingers tends to adduct the wrist (*see* Fig. 6).

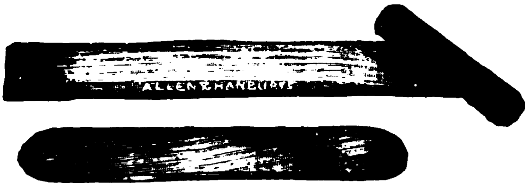


FIG. 6.—Carr's Splint with short back splint.

It must be distinctly understood that if Carr's splint is used the fracture must previously have been carefully reduced.

(*b*) *Fracture of the Styloid Process of the Ulna.*—This usually occurs as a complication of Colles's fracture, and under these circumstances no special treatment is necessary.

When it occurs alone it is usually the result of direct violence. The forearm should then be put up in an anterior splint with the hand in an adducted position.

(*c*) *Separation of the Lower Epiphysis of the Radius.*—This injury is usually the result of direct violence.

The deformity resembles that of a Colles's fracture but without backward rotation of the hand. The treatment is similar to that for a Colles. This injury is likely to lead to interfere with growth of the radius.

FRACTURES OF THE CARPUS.

These injuries were formerly regarded as exceedingly rare, but since it has been the custom to systematically skiagraph the wrist in bad sprains it has been realised that fracture of one of the carpal bones is by no means an uncommon injury.

The bone most usually fractured is the scaphoid, the line of fracture commonly traversing the constricted portion of the bone.

Much more rarely the semilunar, the cuneiform, the os magnum, and even the pisiform have been fractured. Fracture of the scaphoid may complicate a Colles's fracture or may be associated with dislocation of the semilunar. The injury is usually caused by a fall on the outstretched hand.

Confirmation of the diagnosis must be made by a skiagraphic examination. Formerly fracture of the scaphoid was commonly unrecognised and regarded as a sprain. Unless efficiently treated it is liable to be followed by pain and stiffness in the wrist-joint.

When there is no deformity the wrist should be placed on the splint, massage and passive movements of the fingers being commenced the day after the accident. When one of the fragments is displaced an attempt should be made to reduce the deformity by manipulation while the wrist is fully flexed. The hand and forearm should then be fixed with the wrist completely extended. If attempts at reduction are not successful the displaced fragment or the whole bone should be excised.

FRACTURE OF THE METACARPAL BONES.

These fractures are not uncommon, the second, third and fourth metacarpals being the bones most commonly broken. Direct or indirect violence may produce the injury. The former, the more common cause, may be either a blow or crush, while the latter is usually a fall on the hand, or may be the result of a "punch."

The chief danger is that excess of callus may displace the extensor tendons or produce adhesions in the tendon sheaths.

When there is no serious displacement the hand and wrist may be fixed to a well-padded splint. Owing to the danger of adhesions in the tendon sheaths, massage should be commenced early, and the splint be removed daily to allow of movements of the fingers.

When displacement is present reduction may be effected by traction on the corresponding finger combined with direct manipulation. A common device to ensure the maintenance of good position is to make the patient grasp a firm pad of absorbent wool, and to bind the fingers over this in a flexed position. The arm is supported in a sling.

Owing to the danger of stiffness, however, the fingers should be released daily for passive movements.

Fracture of the base of a metacarpal occasionally occurs. It is commonest in the first metacarpal (Bennett's fracture), and is the result of the thumb coming into contact with a hard object. The fracture is oblique and usually involves the joint. If there is deformity this may be remedied as in other metacarpals by flexing the thumb over a palmar pad. When there is no deformity a splint extending from the end of the thumb to a few inches above the wrist-joint should be applied. In either case the apparatus must be removed after the third day for daily movements and massage.

FRACTURE OF THE PHALANGES.

These small bones are not infrequently fractured, usually the result of direct violence. The size of the first phalanges renders them more liable to fracture, which is very unusual in the case of the small terminal phalanges.

The diagnosis is easily made, and reduction may be readily effected by manipulation and traction. The fracture is usually treated by the application of a finger splint extending from the end of the finger into the palm of the hand. The patient will, however, be more comfortable with a small metal trough splint for the finger, with an extension into the palm to fix the metacarpo-phalangeal joint. Whichever apparatus is used, it should be removed daily after the fifth day for movements of the finger, otherwise stiffness of the tendon is likely to result.

These fractures are frequently compound, and in this case the question of amputation will have to be considered, as a stiff finger may be such an inconvenience to a patient as to seriously interfere with the usefulness of the hand.

FRACTURES OF THE PELVIS.

These very severe injuries are almost always caused by direct violence in the form of a crush, such as the passage of a cart-wheel across the body. Much more rarely the force is received by some part of the lower limb, such as the great trochanter, knee or foot. The serious nature of the fracture depends upon the probability of injury to the pelvic viscera. The urethra is most commonly injured, the membranous portion being usually torn.

More rarely the bladder may be ruptured, in which case the rent may be either peritoneal or extra-peritoneal. The bladder is more likely to be damaged when that viscus is distended. Less common complications are injuries to the vagina, rectum or great vessels.

These serious complications are especially likely to be present when the fracture involves the brim of the true pelvis.

The greatest care must be taken in transferring the patient to his home or to the hospital, as any further displacement of the bones, besides causing intense pain and increasing the shock, may injure the pelvic viscera.

Attention must first be directed to the general condition of the patient and the treatment of the shock. It is advisable at once to pass a catheter and note the condition of the urine. If it is blood-stained the catheter is passed at frequent intervals or may be tied in.

In all cases, injury to the pelvic viscera must first of all be sought for, and the general condition of the patient considered, before commencing any treatment.

When the condition of the patient has improved an examination can be carried out to ascertain the nature of the fracture.

If there is any very marked displacement an anæsthetic may be given and an attempt made at reduction.

The patient should be kept on a firm mattress. For nursing purposes he should be lifted evenly and carefully by a firm draw-sheet passing behind the pelvis, and a second band passing behind the lower part of the thighs and knees. To relax the muscles attached to the pelvis, the knees should be slightly flexed.

The pelvis should be supported by a broad firm bandage applied over a thick layer of wool. If the urethra is injured and a catheter cannot be passed, an incision must be made in the perineum and an attempt made to find the proximal end. If this cannot be found a gauze drain must be inserted. A peritoneal rupture of the bladder should be treated by laparotomy and suture of the rent.

An extra-peritoneal injury may be revealed only by the appearance of extravasation and pelvic cellulitis.

The following fractures in which the pelvic ring is not broken, though some of them are very serious, are less likely to be complicated by injury to the viscera, and so are not so dangerous to life as the fractures described above.

Fractures of the Ilium.—As the result of great direct violence a portion of the ilium above the pelvic brim is broken.

Usually a portion of the crest or the anterior superior spine is separated. Displacement is usually slight, and reduction is unnecessary.

The patient is kept at rest in bed with the knees flexed over a pillow, and well propped up to relax the abdominal muscles.

No band round the pelvis is necessary; indeed, by its pressure it may increase the displacement. After three weeks the patient may be allowed to get up.

Fracture of the Ischium.—This rare fracture is usually the result of a fall from a height, the impact being received by the buttock.

The only treatment required is rest in bed for about three weeks. Pressure over the fracture may be avoided by the use of an air pillow. When there is any considerable displacement the patient may lie on his side with the knees flexed to relax the hamstrings.

Fracture of the Acetabulum.—Fracture of the acetabulum may be associated with dislocation of the hip-joint. The violence is received from the head of the femur, and usually the upper and posterior portion of the rim is separated, allowing the head of the femur to slip up on the dorsum ilii. The deformity will be that of a dislocated hip-joint, but the fracture will be recognised on skiagraphic examination. Reduction of the dislocation is usually easy, and crepitus may occur on manipulation. The dislocation easily recurs, sometimes on cessation of the extending force. After reduction of the dislocation weight-extension must be applied by means of a stirrup and pulley. This should be maintained for at least six weeks. If there is great tendency to recurrence of the dislocation, passive movements should not be commenced for two weeks and great caution should be exercised. If there is but little tendency to recurrence, movements should be commenced after the lapse of a few days.

A far more serious injury is *fracture of the floor of the acetabulum*, which is caused by great direct violence transmitted through the neck and head of the femur from the great trochanter.

In the least severe forms there is simply a fissure across the acetabulum. In other cases there is a star-shaped fracture fissure extending to the obturator foramen, the great sacro-sciatic notch, and across the horizontal ramus of the pubes, thus tending to separate the innominate bone into its three primary constituents. In the most severe cases the floor of the acetabulum is extensively splintered, and the head of the femur may even be driven through into the cavity of the true pelvis. These injuries are often obscure, and their exact nature is frequently only revealed on radiographic examination.

The patient may be anæsthetised, when he has recovered from the shock of the injury, and an attempt made to withdraw the head of the femur from the pelvic cavity when this displacement is present. Extension should then be applied by the weight and pulley. Passive movements should be commenced about the tenth day, but serious permanent impairment of movement is almost certain to result. A watch must be kept for any visceral or other complication, and the appropriate treatment adopted. If the acetabulum is fractured without inward displacement of the femur, weight and pulley extension should be applied to the leg and thigh, and a bandage applied to support the pelvis.

Fracture of the Sacrum.—This injury is usually the result of severe direct violence, such as a run-over accident, the patient being in a prone position at the time of the accident.

The line of fracture is usually transverse and crosses the lower part of the bone. The lower fragment is displaced forward with the coccyx, and may press on the rectum and even seriously impede the passage of fæces. The fracture is frequently compound, the rectum may be torn, and injury to the sacral nerves may lead to paralysis of the legs, retention of urine, and incontinence of fæces.

If there is no displacement all that is necessary is to keep the patient at rest in bed in the lateral position, with his hips and knees flexed. If there is much displacement it is best to give an anæsthetic, and manipulate the lower fragment into position by means of two fingers introduced into the rectum.

Rest for four weeks is then maintained in the above position if the fracture is simple, a longer period being required for a compound or complicated fracture. Painful defæcation is a not infrequent sequel, and occasionally there is a good deal of pain in the sitting posture.

Fracture of the Coccyx.—This is usually the result of a kick or a fall on the gluteal region. The separated fragment always is displaced forwards, and may cause considerable pain on defæcation.

The treatment resembles that of fracture of the sacrum.

The separated fragment may be replaced by manipulation with one or two fingers in the rectum, but unfortunately there is a great tendency for the displacement to recur. It is, therefore, necessary to examine from time to time, and if necessary to repeat the process of reduction. In spite of this, union with forward displacement is likely to result, and may lead to a painful condition in the parts in the sitting position and on defæcation known as coccydynia. When this is present the coccyx should be excised.

FRACTURES OF THE FEMUR.

Fractures of the femur may be divided into the following three groups : (1) Fractures of the upper extremity; (2) Fractures of the shaft; (3) Fractures of the lower extremity.

(1) Fractures of the Upper Extremity. — These are very serious injuries, partly on account of the likelihood of permanent shortening or deformity of the limb, and partly owing to their proximity to the hip-joint, movement in which is likely to be seriously interfered with as the result of the accident. The following fractures will be considered under this heading: (*a*) Fractures of the neck; (*b*) Fractures of the great trochanter; (*c*) Separation of the upper epiphysis; (*d*) (i.) Separation of the epiphysis, (ii.) of the great trochanter.

(*a*) *Fractures of the Neck of the Femur.*—These fractures were formerly classified as intra-capsular or extra-capsular according as to whether the hip-joint was involved or not. In a great number of these injuries, however, the line of fracture is partly intra-articular and partly extra-articular.

It is thus best to speak of (i.) fractures of the narrow part of the neck or "sub-capital" fractures, and (ii.) fractures of the base of the neck, remembering that intermediate forms not infrequently occur. The diagnosis of these injuries is frequently a matter of great difficulty. A radiographic examination should always be made, as owing to the deep situation of the fractured bone the exact nature of the injury can as a rule only thus be recognised. Not infrequently it is the only method of definitely ascertaining that a fracture has occurred.

Fractures of the Narrow Part of the Neck.—These fractures frequently occur in old people, especially females, and are then usually the result of some trivial violence, such as a trip or fall, or even turning over in bed. They are, however, by no means uncommon in young adults and even in children.

This clinical fact has been demonstrated by skiagraphic examination, these injuries having previously been regarded as sprains, separated epiphyses, or even tuberculous disease of the joint.

Impaction may be present, and the fragments are usually connected by broad strips of periosteum. These two facts probably explain the slight nature of the symptoms when the fracture occurs in the young, such a patient being occasionally able to walk after the injury. An elderly patient, though unable to walk and usually unable to move the hip, may, however, while lying down be able to gradually flex the joint. Shortening is commonly slight at first, but shows a tendency to increase, though it is seldom more than 1 inch. The limb is in a position of external rotation, so that the foot is everted.

Bony union usually occurs in the young, but in old people there may be fibrous union or even non-union. In old people the prognosis is always serious. Death may result in a day or two from shock, but more usually hypostatic pneumonia appearing after a few days or weeks is a fatal complication.

In old patients it is usually impossible to get bony union, and as prolonged rest in bed is so likely to be fatal, it is best to get them up quickly to lessen the possibility of fatal thoracic complications. If the condition of the patient allows it, she may be kept in bed for fourteen days with extension by a weight and pulley combined with a long Liston's splint, as described below in the treatment of this fracture in younger patients. At the end of this period, or before, if the condition of the chest, pulse, or threatening bed sores indicate it, the patient should be allowed to get up.

If the patient is a female, a Thomas's hip splint should be applied, which allows the patient to get about on crutches. If a male, a plaster spica bandage may be applied. It should be especially strong in the region of the groin, and should extend downwards well below the knee. This will allow the patient to be propped up in bed, and also to move about with the aid of crutches.

In a younger patient bony union may be expected, and every attempt should be made to ensure that this occurs in good position.

The chief points to be aimed at are: (1) To overcome the shortening of the limb, which, though slight at first, is liable to increase as the result of muscular contraction; (2) To correct the eversion of the limb. To prevent shortening, extension is necessary, and to rectify eversion, some form of splint is required.

Extension is best secured by means of the weight and pulley. The loop of strapping is fixed from the upper third of the thigh to the middle of the leg. Extension is then made from the ankle, the patient being anæsthetised if necessary, until the measurement from the anterior superior spine to the tip of the internal malleolus of the injured leg is the same as the corresponding measurement in the sound limb. Eversion is best prevented by the use of the long Liston's splint. (*See* Fig. 7.) This is a long straight splint extending from the patient's axilla to about 1 foot beyond the heel. It is well padded, and, in addition, extra padding is used to avoid undue pressure on bony prominences. The foot is first bandaged to the splint, a few turns of bandage being first taken around the ankle to support the foot.

The whole leg from the ankle to the groin is then firmly bandaged to the splint. The upper portion of the splint above the crest of the ilium may be secured to the trunk by a broad strip of flannel. To prevent the external rotation of the limb the lower part of the splint, just beyond the foot, should be allowed to rest in a groove in a thick block of wood, the long axis of which is at right angles to the axis of the splint.

If some such plan is not used eversion of the foot will soon occur, the limb carrying the splint with it as it rotates.

After an interval of twelve hours, to allow the strapping to become firmly fixed, weight-extension must be applied.

It is as well to commence with about 5 lb., which, however, may be increased to 10, 15, or even more if any shortening should appear. The patient must be kept in the recumbent position in the apparatus for about two months. He should then be allowed to get about on crutches, either with a Thomas's hip splint or with a plaster spica bandage, for one month further before making any attempts to use the limb.

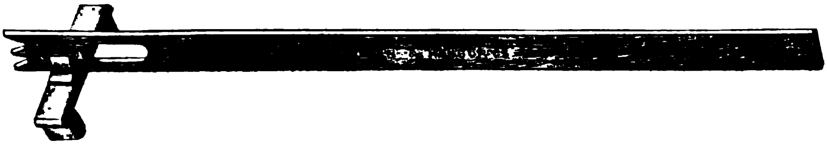


FIG. 7.—Liston's Splint, with grooved block to prevent external rotation.

Fractures through the Base of the Neck.—In these injuries, formerly known as extra-capsular fractures, the line of fracture generally follows the inter-trochanteric lines, and thus the joint is usually opened on its anterior aspect. Great direct violence received by the great trochanter, for instance, after a fall, is the usual cause.

These fractures usually occur in younger patients, who can without harm remain in bed, and in whom bony union may be expected. If there is but little shortening or deformity it is best not to break down the impaction, but to rely on prolonged extension to overcome these defects. Should, however, a marked deformity occur in a young and healthy patient, it is best to give an anæsthetic and apply strong extension with the limb in an abducted position. An assistant should steady and apply counter-extension from the pelvis. These fractures should be treated in a similar manner to that described above for fractures through the narrow part of the neck, viz., by applying extension by means of the weight and pulley, and correcting external rotation by means of a long

Liston's splint. This treatment must be maintained for at least six weeks, when the patient may be allowed to get about on crutches in a Thomas's hip splint. Massage to the muscles of the leg and passive movements at the hip, knee and ankle joints must then be carried out daily. If preferred, a plaster of paris spica bandage may be used, especially strengthened in the region of the groin. The patient is able to get about on crutches, but the objection to this method is that the daily massage, etc., cannot be carried out.

In cases where there is great displacement which cannot be satisfactorily reduced by manipulation, open operation may be necessary.

(b) *Fracture of the Great Trochanter.*—The great trochanter is frequently split in fractures at the base of the neck, but in addition to this it may be separated usually as the result of direct violence.

If separation is but slight, all that is required is rest in the recumbent position for two or three weeks, movement at the hip-joint being checked by the use of a Liston's splint. The patient may then be fitted with a Thomas's hip splint, and be allowed to get about on crutches for a further period of three weeks. If there is considerable separation, open operation, with direct fixation of the fragments, gives the only chance of union in a good position.

(c) *Separation of the Upper Epiphysis.*—This is a rare injury, probably more so than fractures of the narrow part of the neck. It occurs in patients under twenty years of age, at which time the epiphysis joins the neck. It is generally the result of indirect violence. Separation is usually partial, and probably is an important cause of coxa vara.

The treatment is similar to that of fracture of the neck.

Extension is maintained by a stirrup weight and pulley, and a Liston's splint used to keep the limb at rest in a good position.

After four weeks the patient is allowed to get about wearing a Thomas's splint, and massage and passive movements of the joints are carried out daily.

(d) *Separation of the Epiphysis of the Great Trochanter.*—This is a very rare injury caused by direct violence.

There is usually no displacement owing to the aponeurosis being untorn. The only treatment necessary is to keep the hip at rest for about four weeks by means of a Liston's splint.

(2) **Fractures of the Shaft of the Femur.**—The shaft may be fractured as the result of direct or indirect violence, or even as the result of muscular action. The line of fracture may be transverse, especially in children, or oblique, as is usually the case in adults.

The displacement and deformity depend upon the direction of the fracturing force, the action of muscles and the effect of gravity upon the weight of the limb. There may also be considerable local swelling from the effusion of blood. When the fracture is in the upper third the upper fragment is usually in an abducted and flexed position, probably owing to the action of the ilio psoas and the glutei, while the lower fragment is adducted probably by the adductor magnus, and displaced upwards by the action of quadriceps and hamstrings. When the fracture is near the centre of the shaft, flexion of the upper fragment is less marked, but there is usually a marked overlapping, the lower fragment passing to the inner side of the upper. In the lower third of the shaft (supracondyloid fractures) the small lower fragment is displaced backwards, probably by the action of the gastrocnemius, so that it lies behind the lower end of the upper fragment.

As the result of these displacements there is usually well-marked shortening, possibly as much as 2 or 3 inches.

The lower fragment with the leg and foot are in addition rotated outwards as the result of the action of gravity on the unsupported limb. The diagnosis is generally easy, but a radiographic examination is always desirable to investigate the character of the fracture and the nature of the displacement.

Before the application of a splint the fragments must be restored to good position. When the fracture is oblique and near the centre of the shaft the displacement with the resultant shortening may be overcome by traction. Usually, however, the displacement and deformity re-appear on ceasing to extend the limb.

In these cases it is obviously of the greatest importance to maintain extension for some considerable time. In cases of fracture in the upper third of the shaft the upper fragment is too small to manipulate, and hence the fracture must be reduced by traction in a flexed and abducted position. With supra-condyloid fractures reduction is especially difficult owing to the backward rotation and displacement of the lower fragment. The patient should be anæsthetised and the knee fully flexed. The surgeon then makes steady traction by grasping the leg just below the knee, while an assistant supports and applies counter-extension to the thigh. Occasionally when the pointed extremity of an oblique fracture has pierced the muscle satisfactory reduction is impossible. An open operation is then strongly indicated. The apparatus for maintaining the fragments in position will depend partly upon the site of the fracture and partly upon the nature of the displacement.

The following methods are those usually employed, and the special indications for each will be mentioned at the conclusion of each description:

Hodgen's Splint.—This consists of a stout wire framework, the shape of which is indicated in Fig. 8. It should extend from the groin to about 9 inches beyond the foot, and is bent just above the middle to allow the knee to assume a slightly flexed position. It is used in conjunction with a strong vertical support of iron or wood, which can be firmly fixed to the foot of the bed (*see* Fig. 9). Before the splint is applied a stirrup-extension apparatus is fixed to the leg from just below the knee to within 3 inches of the malleoli. A Liston's splint may be temporarily used while the stirrup is becoming firmly adherent.

A series of strips of thick flannel about 4 inches wide are then sewn to one side of the wire framework. The splint is placed in position *over* the injured leg so that the upper cross-piece closely follows the line of Poupart's ligament.

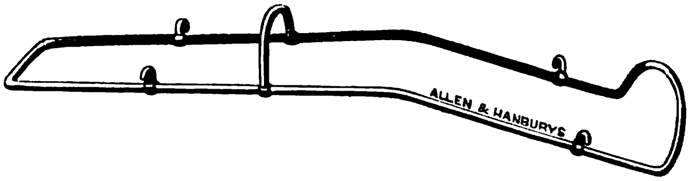


FIG. 8.—Hodgen's Splint.

The strips of flannel are then passed *under* the leg and secured by sewing or by safety pins to the opposite side.

The leg is thus slung from the supporting framework with the knee in a slightly flexed position. The cord of the stirrup is firmly tied to the cross-piece at the lower end of the splint.

Four cords are attached to two pairs of hooks which project from the side of the splint, one pair being a short distance above the knee, and the other a few inches above the ankle.

These four cords pass through a ring to which a single strong cord is attached. The limb is then raised from the bed, and when the hip is sufficiently flexed to bring the lower fragment in a line with the upper this cord is attached to one of the hooks on the upright support. External rotation of the leg may be corrected by shortening the outer pair of cords.

Though apparently complicated the action of this splint is really very simple, and may be best explained by the parallelogram of forces. The force acting along the single cord may be resolved into a vertical component which raises the limb, and a horizontal component which tends to pull the splint off the limb.

This, indeed, is what would happen were it not for the cord passing from the stirrup to the end of the splint.

This becomes very tense, and thus the horizontal force is used in continuously drawing the splint with the lower fragment in the direction of the upper fragment.

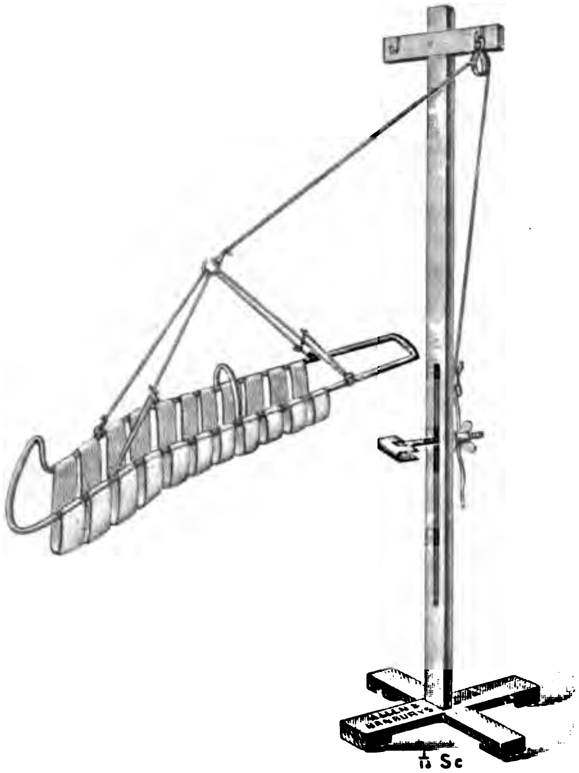


FIG. 9.—Hodgen's Splint, with vertical support.

Hodgen's splint gives excellent results, but it must always be used after a careful investigation of the position of the fragments, for by altering the direction of the cords the direction of the extending force may be considerably varied. Thus, if the upper fragment be markedly abducted, by altering the position of the vertical support at the foot of the bed towards the affected side extension of the lower fragment is kept up in the abducted position.

Flexion of the lower fragment may be increased by raising the height of the vertical support or by approximating it towards the patient's leg. On the other hand, if there is overlapping of the fragments with but little flexion, the vertical support should be lowered or removed further from the patient. In this way it is possible to get an almost horizontal pull.

This splint will be found exceedingly comfortable by the patient, as it allows a considerable amount of movement, and permits of him being propped up in bed. It is also very convenient from the nursing point of view.

The patient should be kept in this splint for at least six weeks. It may then be removed and a Thomas's hip splint applied or a plaster spica bandage. The patient may then be allowed to get about with crutches, wearing a patten on the boot of the sound leg. Massage and passive movements should be carried out daily, and he may be allowed to walk after the lapse of another six weeks.

Hodgen's splint may be used for any fracture of the shaft of the femur, but it is especially indicated when there is flexion of the upper fragment, as is the case in fractures above the middle of the shaft. It may also be used in supra-condyloid fractures, but in this case the splint should be bent so that the knee is flexed to nearly a right angle in order to rectify the backward rotation of the lower fragment.

A fracture of the shaft of the femur in a child cannot be satisfactorily treated by means of a Hodgen's splint, partly owing to the small size of the limb and in part to the restless nature of the patient.

Bryant's Suspension Apparatus is especially useful in the treatment of children under the age of three.

Two vertical supports are fitted, one to the head and the other to the foot of the cot. These are connected by a cross-piece.

A stirrup is then fixed to the affected leg, the strapping being fixed from just above the knee to a short distance above the ankle. The cord from the stirrup is fixed to the cross-piece above the cot in such a way that the child's pelvis is just raised from the bed. Extension is thus kept up by the weight of the lower part of the child's body. The sound limb must also be attached to the cross-piece, as otherwise the child will tend to support the weight of the body by this limb, and thus neutralise the extension. Strapping, however, is not necessary on this side, as a supporting sling round the ankle may be fixed in position by a bandage. The child is quite happy in this position, and firm union in good position may be confidently expected.

After a month the extension may be removed, and the limb should then be supported by a plaster bandage for another month before it is used.

Bryant's Splint is a useful apparatus for the treatment of fractures of the shaft of the femur in children over four years old (*see* Fig. 10).

It consists of two long side splints extending from the side of the chest to well beyond the foot. They are connected by two metal cross-pieces, which can be adjusted so that the splints rest comfortably against the patient, while metal bars replace the wood opposite the great trochanter and so prevent undue pressure on that process. A stirrup extension, commencing just above the knee, is attached to the injured limb. The child is then placed in the splint, and the sound leg is firmly fixed to one of the lateral portions, the foot resting against a foot-piece, which can be adjusted and then firmly screwed in position. The injured limb is now secured to the opposite side of the splint from which the foot-piece has been removed, and the upper part of the splint is secured to the thorax and abdomen by broad flannel bandages.

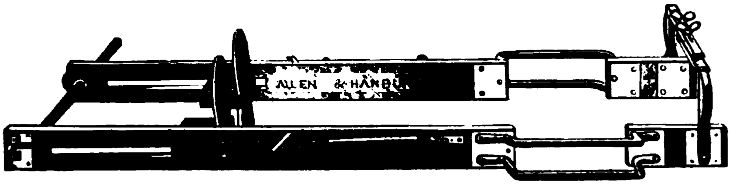


FIG. 10.—Bryant's Splint. Extension is here obtained by an elastic band on the outer side.

The cord from the stirrup passes round two pulleys and is attached to an elastic spring on the outer side of the splint, which thus produces extension of the lower fragment. If more powerful extension should be required the cord may pass over a pulley at the foot of the bed, and the necessary weight be applied.

As originally designed, the splint was provided with a foot-piece moving in a slot, and extension was obtained by means of a cord passing from it round the pulleys to the spring on the outer side of the splint. Owing to the friction, efficient extension can never be obtained in this way, and so the stirrup should always be used. The splint should remain in position for five weeks, after which a plaster bandage should be applied.

Liston's Splint with Extension.—This method has already been described in the treatment of fractures of the neck of the bone.

A stirrup extension must first be applied commencing well above the knee. The splint should extend from the axilla to about 9 inches beyond the foot.

It must be well padded so as to avoid undue pressure in the axilla or over the bony prominences. A band passing round the perineum, and attached to two holes near the upper end of the splint, should be used as an additional support. The splint may be attached to the trunk and injured limb by broad, strong bandages. Better still, two broad, strong pieces of sheeting may be used for this purpose. The upper should extend from the axilla to the iliac crest, and the lower from the groin to the malleoli. Weight extension may be applied on the following day. At first 6 lb. may be used, but if necessary this may be increased to 12 lb. or more. The splint should be kept in position for six or eight weeks, after which a hip splint or plaster of paris spica may be applied, when the patient may be allowed to get about on crutches.

This method of treatment has the advantage of simplicity, and may be used in healthy adults, especially when there is no flexion of the upper fragment, but merely some overlapping leading to shortening of the limb.

MacIntyre's Splint. — This splint is occasionally used for fractures in the supra-condyloid region when there is backward rotation of the lower fragment. It consists of two trough-shaped metal supports, the upper for the thigh and the lower, which is provided with a foot-piece, for the leg. These two portions are jointed together behind the knee, which is thus held in a flexed position. A screw behind the splint enables the extent of flexion to be adjusted (*see* Fig. 11). Before the splint is applied the fracture must be reduced after an anæsthetic has been administered.

When in position the splint should be slung from a cradle.

The chief objection to this splint is that, although the backward rotation of the lower fragment may be rectified, it is difficult to get adequate extension.

The position of full flexion of the knee joint as recommended by Hutchinson and Barnard for separation of the lower epiphysis (*q.v.*) may also be used in the treatment of a supra-condylar fracture.

(3) **Fractures of the Lower Extremity of the Femur.**—The following fractures will be included in this group: (*a*) Fracture of the internal or external condyles; (*b*) T-shaped fracture (intercondyloid fracture); (*c*) Separation of the lower epiphysis.

These fractures are all caused by great direct violence.

In all of them the line of fracture opens the knee-joint, which thus becomes distended with effused blood and inflammatory products.

Stiffness of the knee is very likely to result from these injuries. In all cases a radiographic examination should be made. In this way alone can the displacement be recognised, and only after such an examination can the most satisfactory method of treatment be selected.

(*a*) *Fracture of either Condyle.*—Swelling, pain, crepitus and lateral movement at the knee-joint are usually present after this injury.

When the external condyle is separated the leg is usually in a position of *genu valgum*, while after fracture of the internal condyle a position of *genu varum* is likely.

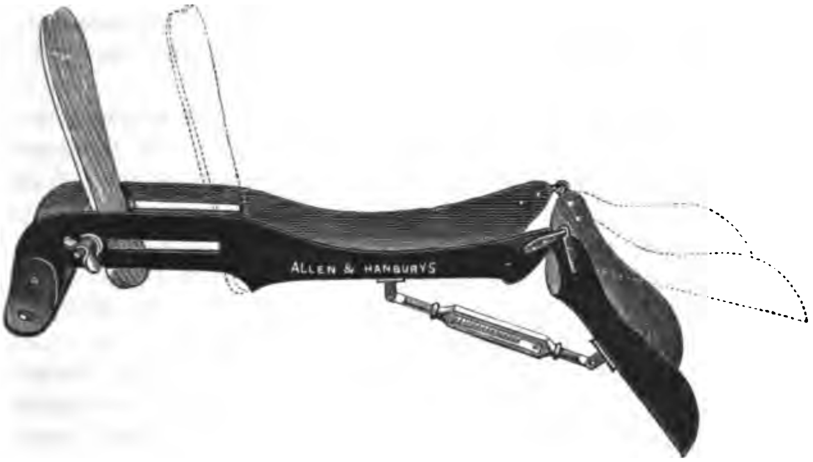


FIG. 11.—MacIntyre's Splint.

An anæsthetic is administered, and an attempt is made to manipulate the separated fragment into good position.

This is more likely to be successful if the knee is flexed to relax surrounding structures. A Croft's plaster splint may then be applied, reaching from the upper part of the thigh to the ankle. This may be cut up on the following day to allow of the early use of massage and passive movements.

A MacIntyre's splint may be tried if the condyle is displaced backwards, while a long external splint may be used when the limb shows a marked condition of *genu valgum.*

In all cases where the displacement cannot be satisfactorily reduced or shows a tendency to recur, the condyle should be fixed in exact position after an open operation.

(*b*) T-*shaped or Inter-condyloid Fracture*—This is an exceedingly severe injury. The shaft is fractured immediately above the condyles, which are separated by a vertical line of fracture extending into the joint.

Owing to the extensive injury to the knee-joint, stiffness is very likely to result.

An anæsthetic should be administered, and an attempt then made to manipulate the fragments into good position. If this can be satisfactorily accomplished the leg may be placed on a MacIntyre splint. In most cases satisfactory apposition of the fragments is impossible, and operative treatments alone will offer any prospect of a movable knee-joint.

If the fracture is compound, amputation is frequently necessary, either shortly after the injury or later, owing to the suppuration which is likely to occur.

(*c*) *Separation of the Lower Epiphysis.*—This rare accident may result from direct violence or from over-extension of the knee-joint. The epiphysis is usually displaced forwards, so that if the separation is complete the lower end of the shaft projects into the popliteal space, where it may damage the great vessels. The knee-joint is always opened, and the injury may be compound.

This injury is very likely to be followed by defective growth at the epiphysial line, leading to shortening of the bone.

The displacement may be reduced in the following manner described by Hutchinson and Barnard: An anæsthetic is administered, and when the muscles are fully relaxed an assistant makes steady extension on the leg. The surgeon then grasps the thigh and flexes both the knee and hip joints. The epiphysis can in this way be made to move backwards into its normal position.

To maintain this the knee should be flexed to an angle of 60 degrees, and kept in this position by a bandage passing round the thigh and the leg just above the ankle.

The limb is then everted so that it rests on its outer side. It is kept at rest by means of sand-bags and evaporating lotion, or an ice-bag may be applied to the swollen knee.

Massage and passive movements may be cautiously commenced after ten days.

FRACTURES OF THE PATELLA.

Fracture of the patella is a common accident. It is usually the result of a violent contraction of the quadriceps extensor muscle in an effort to preserve the balance after a stumble or fall. It may, however, be caused by some direct violence, such as a violent blow on the bone. In the former case the fracture is transverse, and is usually situated nearer the lower than the upper end of the bone. Owing to the contraction of the muscle the upper fragment is drawn upwards and may be separated by 1½ to 2 inches from the smaller lower fragment, which is usually tilted, so that the fractured surface looks slightly forward. The aponeurosis covering the patella is always torn, and very commonly the irregular torn ends hang down between the fragments. The joint is always involved and is rapidly distended by blood and inflammatory effusion.

When the fracture is the result of direct injury the joint is tender and swollen. The fracture is usually not transverse, but there are a number of fissures which may have a star-like arrangement. The aponeurosis is not torn, and thus there is usually no displacement.

Treatment is essentially different in the two varieties of fracture. When the fracture is transverse it is extremely unlikely that bony union will be obtained if treatment by splints alone is tried. This is owing to the wide separation of the fragments, which is partly due to the contraction of the quadriceps and partly to the effusion into the joint.

The torn aponeurosis, too, will probably get between the fractured surfaces and so prevent them from being brought into contact. The result is that only fibrous union can be expected, though it must be remembered that bony union does occur in rare cases. Even with fibrous union a very useful joint and limb may be obtained if the fragments have been so closely approximated that they are connected by a layer of fibrous tissue from ¼ to ½ inch in length. Too often, however, "long" fibrous union occurs when the fragments are connected by a layer of fibrous tissue from 1 to 2 inches or even more in length.

"Short" fibrous union, too, may stretch and so become "long." Under these circumstances the knee-joint is weak and readily gives way, and power of extension is very deficient.

Firm bony union can only be certainly obtained by cutting down on the fragments, washing the effused blood from the joint, removing intervening shreds of aponeurosis, and then directly uniting the fragments in exact apposition. The treatment of transverse fracture of the patella is thus essentially operative.

In some cases, however, operation may be refused, or owing to the age of the patient or to some constitutional condition, it may be undesirable. Under these circumstances the fracture may be treated in the following manner: The leg is fixed to a long back splint with a foot-piece, which is raised as much as possible by means of a thick wedge pillow to relax the quadriceps. An ice-bag or evaporating lotions are then applied to the swollen knee. After a few days when the swelling has subsided, an attempt is made to approximate the fragments. The lower of the two fragments is first of all fixed by several pieces of strapping passing from below obliquely upwards and backwards.

A thick piece of strapping cut to a U shape is applied to the front of the thigh in such a manner that the upper fragment of the broken bone fits into the concavity of the U. Cords are then attached to each limb of the U, and these are connected with an elastic spring apparatus which is attached to the foot-piece. The fragments are in this way brought together. This apparatus should be worn for eight weeks, but after four weeks massage may be started with cautious movements in the knee-joint. When the splint and strapping have been removed a plaster splint should be applied, which is cut up on the following day, and the patient may then be allowed to get about on crutches. The splint must be removed daily for massage and passive movements.

When the fracture is due to direct violence, even when the fracture is starred, there is no separation of the fragments since the aponeurosis remains untorn. Indeed, with this variety of fracture the patient may even be able to walk, though with considerable pain. Bony union may be expected without resort to operative treatment. The leg is placed on a back splint with a foot-piece. A wedge pillow should be used to raise the splint and so relax the quadriceps, while an ice-bag may be applied to reduce the swelling. Massage and gentle movements of the joint should be commenced on the third day.

Bony union will occur in about a month, when the patient may be allowed to gradually use the joint.

FRACTURES OF THE TIBIA AND THE FIBULA.

Either the tibia or the fibula may be fractured alone, but very frequently both bones of the leg are fractured simultaneously. In the former case the uninjured bone will act as a splint and so tend to prevent shortening or lateral displacement. In the latter considerable shortening may be present, especially if the line of fracture is oblique. Fractures of the upper or lower extremities are likely to involve the knee or ankle joints. Stiffness or deformity of these articulations is then liable to produce some serious permanent disability. Another common sequela of these injuries is a painful œdematous condition of the limb beyond the fracture; it appears when the patient begins to get about, is very persistent and may cause serious impairment of function.

Fractures of both bones will be considered together. They may be classified in the three following groups: (1) Fractures of the upper extremities; (2) Fractures of the shafts; (3) Fractures of the lower extremities.

(1) **Fractures of the Upper Extremity.**—In this group are included the following fractures of the tibia. The small head of the fibula is so well protected that it is very seldom fractured: (*a*) Fractures of the tuberosities; (*b*) Fractures of the spine; (*c*) Separation of the upper epiphysis.

(*a*) *Fractures of the Tuberosities of the Tibia.*—These injuries are usually the result of direct violence. They may be caused by a fall, the impact being received by the foot of the force transmitted to the head of the tibia, which is violently driven against the condyles of the femur.

Either tuberosity may be detached or a T-shaped fracture result, both tuberosities being separated from the shaft with a vertical fracture extending between them and opening the knee-joint.

To reduce the fracture the patient should be anæsthetised, and, with the knee flexed, the fragments are then manipulated into position. If both tuberosities are fractured extension is desirable. A stirrup apparatus should be attached to the leg from the level of the tubercle of the tibia to just above the malleoli. A weight is attached to the cord, which passes over the pulley at the foot of the bed after twenty-four hours; 4 lb. may be tried at first, but this can be increased if necessary. A back splint extending from the upper part of the thigh to within a short distance of the heel should also be used to immobilise the knee-joint. At the end of ten days this apparatus should be removed and a Croft's plaster splint applied. Massage should be commenced on the second day, the splint being removed daily for repetition of this treatment. Passive movements of the knee-joint are commenced on the tenth day and are repeated daily with the massage.

When one tuberosity alone is detached it is manipulated into position as directed above. The leg may then be placed on a MacIntyre's splint, since flexion of the knee-joint relaxes the muscles and diminishes the likelihood of recurrence of the displacement. The splint is removed at the end of ten days, when a plaster splint is applied and massage and passive movements are started.

MacIntyre's splint is sometimes used when both tuberosities are fractured, but it has the serious disadvantage that extension cannot be employed.

In these fractures operative treatment with direct fixation of the fragments will in many cases give the best chance of a movable joint.

(*b*) *Fracture of the Spine of the Tibia.*—This rare injury is usually the result of a twist, the force being applied through the crucial ligaments. The knee is painful and swollen and may be "locked," so that the symptoms closely resemble those of a displaced semilunar cartilage or loose body. The diagnosis will be made only after a radiographic examination. A back splint may be applied and massage and passive movements commenced at once. It has also been suggested that the joint should be opened and the small fragment freed from the ligaments and removed.

(*c*) *Separation of the Upper Epiphysis of the Tibia.*—This unusual injury is usually the result of a severe wrench of the knee-joint. Separation is usually partial, the epiphysis being displaced forwards and tilted upwards by the action of the quadriceps.

Reduction is said to be readily effected by manipulation, the knee being flexed and the patient anæsthetised. A Croft's splint may then be applied, or if there is much swelling a back splint may be used until this subsides. Massage and passive movements should be started early. The patient can get about on crutches after two weeks, and may be allowed to walk at the end of eight weeks.

(2) **Fractures of the Shafts of the Tibia and Fibula.**—In this group are included: (*a*) Fracture of the shaft of the fibula alone; (*b*) Fracture of the shaft of the tibia alone; (*c*) Fracture of the shafts of the tibia and fibula.

(*a*) *Fracture of the Shaft of the Fibula.*—This is a very frequent injury. There are two common sites of fracture: (i.) At the junction of the upper and middle thirds; (ii.) about 4 inches above the external malleolus. In the latter situation the cause is usually violent eversion of the foot, but in the present group of fractures the ankle-joint is uninjured and the foot not displaced. Fractures at a higher level may be the result of direct violence.

The patient should be kept in bed for three or four days with the injured limb immobilised on a back splint. Evaporating lotions may be applied if there is much swelling. A plaster of paris splint, either Croft's or a Bavarian, should then be applied. It is cut up on the following day, and the patient may then be allowed to get about with the help of crutches. It should be removed from time to time for passive movements of the ankle-joint, especially when the fracture is near the lower extremity of the bone. At the end of three weeks the splint may be removed and the patient allowed to walk.

(*b*) *Fracture of the Shaft of the Tibia.*—This injury is usually the result of considerable direct violence, and may then occur anywhere in the extent of the bone. The line of fracture when thus produced is usually nearly transverse; but even when it is oblique there will be but little displacement or shortening, as the fibula is uninjured. The diagnosis is usually easy. There will be pain, localised especially to the site of the fracture, with swelling and bruising. As the anterior border of the bone is subcutaneous, any irregularity in this situation can usually be readily recognised.

In most cases, as there is but little displacement and no shortening, reduction is unnecessary. Occasionally the lower end of the upper fragment is displaced forwards, so that it forms a prominence beneath the skin. Reduction may then be effected by applying extension from the leg, the knee being flexed to relax the tendo Achillis while counter-extension is applied from the thigh.

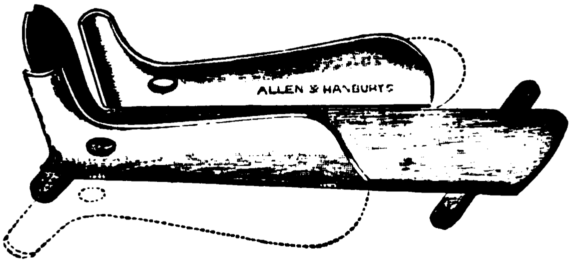


FIG. 12. —Back and side splints.

When there is no displacement the leg should be placed on a back splint with a foot-piece extending above to the middle of the thigh. In fixing the foot to the vertical foot-piece care must be taken to place a thick pad of wool between the splint and the tendo Achillis; the heel as well as the heads of the metatarsals should be in contact with the foot-piece. If this precaution is not taken there will be a certain amount of plantar flexion at the ankle-joint, and the foot will assume a position of talipes equinus, which it may be a difficult matter to overcome later on. After the back splint is in position two well-padded side splints extending from the knee to the foot are fixed in position by means of tapes and buckles (*see* Fig. 12). When there is a tendency to forward displacement of the upper fragment the limb should be put up with the knee flexed to relax the tendo Achillis. This may be accomplished by using a short back splint reaching above only to the knee. This is applied in a similar manner to the longer splint described above, and side splints should also be used. Flexion of the knee is obtained by slinging the leg from a cradle.

An objection to this method is that movements are allowed at the knee-joint, and hence the upper fragment may be insufficiently fixed. This objection may be overcome by using a MacIntyre's splint. The thigh is thus supported by fixation to the upper part of the splint while, by means of a screw connecting the upper and lower portions supporting the thigh and leg respectively, the necessary flexion of the knee-joint may be obtained.

In all cases it is desirable to start massage as early as the second or third day. The limb may be exposed for this purpose by removing the side splints and cutting up the bandage, securing the back splint, which, however, is allowed to remain in position. This should be repeated daily. At the end of a week the back splint should be displaced to allow passive movements of the knee and ankle joints.

At the end of three weeks the back and side splints should be removed and a plaster splint, either Croft's or a Bavarian, should be applied. The patient may then be allowed to get about on crutches, the splint being still removed daily for massage and passive movements. After the lapse of another four weeks the patient may be allowed to walk.

A plaster of paris splint may be used from the first, especially when the displacement is but slight or is readily reduced, and there is but little swelling. The plaster splint should be cut up at the end of twenty-four hours to allow the commencement of daily massage.

The toes, too, must be carefully watched to make sure that there is no harmful constriction of the limb, for effusion of blood may lead to an increase of the swelling even after the application of the splint.

(*c*) *Fracture of the Shafts of the Tibia and the Fibula.*—This is an extremely common injury, and is not infrequently followed by serious disability. It may be the result of a fall, or may be caused by direct violence, such as a violent blow or the passage of a wheel over the leg. The tibia is most commonly fractured near the junction of the middle and lower thirds, which is the weakest part of the bone. The fibula usually gives at a higher level. When, however, direct violence is the cause, the fracture may occur at any portion of their extent.

A fracture of the tibia and fibula must always be regarded as a serious injury, since shortening, injury to soft parts, stiffness of joints and tendons, or œdema may lead to some lasting pain or lameness.

A radiographic examination should always be made, so that the nature of the displacement may be thoroughly investigated. This should be repeated after the reduction of the displacement in order to make sure that the fragments are in good position. In many cases the displacement is found to be of such a nature that an open operation with direct fixation of the fragments gives the only possible hope of union in a good position.

To reduce the fracture the patient should be anæsthetised. Steady extension should then be made from the ankle, an assistant steadying the limb and applying counter-extension from the thigh. The knee should, if necessary, be flexed to relax the muscles of the calf, the contraction of which has a strong action in keeping up the deformity. Some surgeons divide the tendo Achillis, but this is very rarely necessary if manipulation is carried out after flexion of the knee. The following are the methods of immobilising the fracture:

(i.) By means of Long Back and Side Splints.—These are applied as described above for fracture of the tibia alone. Care must be taken to avoid any pressure over the site of the fracture, since the bruised skin may easily slough if compressed between the bandage and the bone. A thick pad of wool is placed between the splint and the tendo Achillis, and care must be taken to see that the foot rests evenly against the vertical foot-piece. The side splints are then applied, pads of wool being inserted between these and the bony prominences.

Daily massage should commence on the third day, the leg remaining in contact with the back splint while this treatment is carried out. Movements of the toes may be started at the same time, while passive movements of the knee and ankle joints are commenced at the end of the first week.

At the end of three weeks a plaster splint is applied, but the patient should not be allowed to bear any weight on the foot until eight weeks after the injury. If massage has been carried out, firm union may be expected by this time, but it is as well before allowing the patient to walk to investigate the solidity of the union, since "delayed union" sometimes occurs with these fractures.

(ii.) Short Back Splint and Side Splints.—This method is especially useful when, owing to the displacement of the lower fragment, it is necessary to flex the knee in order to relax the muscles of the calf. The back splint extends above to the level of the knee-joint, and after the side splints have been applied the limb is comfortably slung from a cradle so that the requisite degree of flexion is obtained.

Flexion of the knee may also be obtained by using a long back splint with a hinge opposite the knee joint (*see* Fig. 13).

(iii.) Plaster of Paris Splints.—A Croft's or Bavarian splint may be applied from the commencement of treatment in those cases where reduction is easily carried out, and where swelling and bruising are not extensive. In these cases the splint should be cut up at the end of twenty-four hours. The splint can then be opened out daily for the massage treatment.

(3) **Fractures of the Tibia and Fibula involving the Ankle-Joint.**—These fracturesare of the greatest importance, on account of the likelihood of some permanent deformity or stiffness of the joints leading to serious interference with the normal function of the part.

The following fractures are included in this group: (*a*) Fracture of the internal malleolus (Wagstaffe's fracture); (*b*) "Pott's" fracture; (*c*) Separated lower epiphysis of the tibia.

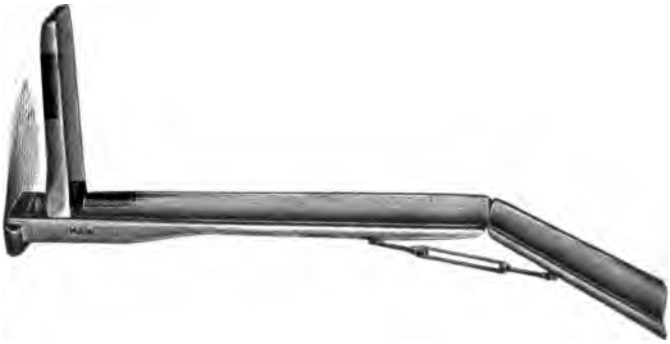


FIG. 13.—Back splint, hinged to allow flexion of knee joint.

(*a*) *Fracture of the Internal Malleolus.*—The internal malleolus is frequently fractured, together with the fibula in Pott's fracture. It may, however, be broken alone either as the result of direct violence or after violent inversion of the foot. In the former case displacement will be slight, but in the latter the foot may be markedly inverted with backward displacement of the astragalus and plantar flexion of the foot. A radiographic examination should always be made to make sure that the astragalus maintains its normal relation to the tibia.

If there is no displacement of the foot, the limb should be kept at rest on a back splint provided with a foot-piece and extending above to the middle of the thigh. As the ankle-joint is necessarily involved, massage and passive movements should be commenced on the following day. At the end of ten days a Croft or Bavarian may be substituted for the back splint, and at the end of three weeks the patient may be allowed to walk.

When there is displacement of the foot the deformity should be reduced after an anæsthetic has been administered, care being taken that the inversion is not over-corrected. The limb is then put up on short back and side splints and slung from a cradle in order to relax the tendo Achillis. The subsequent treatment will be similar to that required for a Pott's fracture.

(*b*) "*Pott's*" *Fracture.*—This term, which is somewhat loosely used, is applied to a fracture of the lower end of the fibula, associated with a partial displacement of the ankle-joint. The foot is displaced outwards with the astragalus and the external malleolus. The consequent strain on the internal lateral ligament of the ankle-joint leads to its rupture or to a fracture of the internal malleolus.

Dupuytren's fracture is a more severe form of this injury. It also is produced by violent eversion of the foot; but either the inferior tibio-fibular ligament is ruptured, or the portion of the outer surface of the inferior extremity of the tibia to which this ligament is attached is fractured. As the result of this the bones are separated at the inferior tibio-fibular joint, thus allowing excessive outward displacement of the foot. In the most marked cases the astragalus may be forced upwards between the tibia and the fibula.

Another and rarer variety of Pott's fracture is produced by violent inversion of the foot. The internal malleolus will then be fractured first, and the force continuing to act will lead to a fracture of the lower part of the fibula. The astragalus and the foot will in this case be displaced inwards and strongly inverted.

For the satisfactory reduction of the fracture the patient must be anæsthetised. An assistant then flexes the patient's knee to relax the calf muscles and steadies the upper part of the leg. The surgeon then manipulates the foot into position, taking care to remedy the backward displacement of the foot as well as the eversion and the outward displacement. In some cases reduction is easy, in others it may be impossible by manipulation to get the fragments into good position. When the deformity has been overcome the leg must be immobilised on a splint, with the foot at right angles and in a position of slight inversion. The following are the chief methods used:

(i.) Croft's Splint.—This must be applied after reduction while the patient is still anæsthetised. It is especially indicated when reduction is easily brought about, and where there is no marked swelling and no spasm of the calf muscles. The splint should extend from the lower part of the thigh to the heads of the metatarsals. The foot must be held in a position of slight inversion and at right angles to the leg until the plaster has firmly set. In cases where there is much tendency to backward displacement of the foot a short Croft's splint, extending above to the level of the tubercle of the tibia, may be used, so that the leg may be slung from a cradle to relax the calf muscles. In such a case, however, it will be probably better to use either back and side splints or a Roughton's splint.

(ii.) Back and Side Splints.—A short back splint extending above as far as the back of the knee should be selected. A pad of wool should be placed so as to support the heel and press the foot forwards. Before the side splints are applied a pad should be placed on the outer side of the foot to guard against any recurrence of the eversion. Care must also be taken to see that the foot is at right angles to the leg. The limb is then slung from a cradle so as to flex the knee and relax the muscles of the calf (*see* Fig. 14).

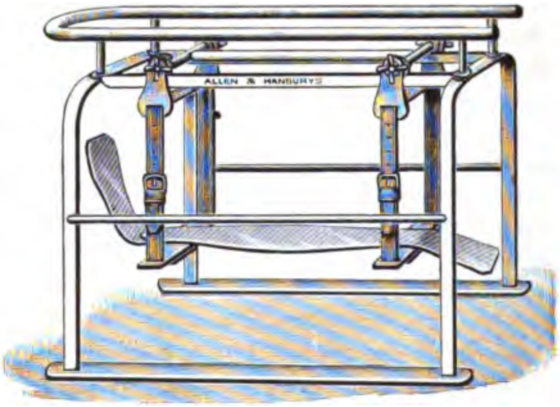


FIG. 14.—Short back splint suspended from cradle to allow flexed position of knee joint.

(iii.) Roughton's Splint.—This is a short outside splint extending from the foot to the level of the knee. It is provided with a vertical foot-piece which has a support for the outer border of the foot as an additional security against eversion. The deformity having been reduced, the limb is placed on the splint, additional pads being used if necessary to secure a position of slight inversion. The whole length of the sole of the foot must be in contact with the foot-piece. The splint is fixed in position by three broad tapes, two passing round the limb below the knee; the third, just above the ankle, passes round the heel and then across the instep to surround the foot-piece or external vertical support. The effect of this is to draw the foot forwards. A short internal splint may also be used, and is secured in position by a bandage. The leg should be allowed to rest on its outer side with the knee well flexed.

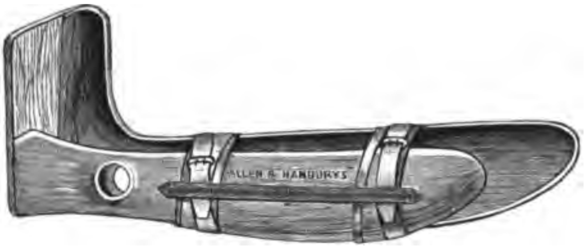


FIG. 15.—Roughton's Splint.

(iv.) Dupuytren's Splint.—This resembles in shape a Liston's splint. It is placed on the inner side of the limb, and extends from the knee to a short distance beyond the sole of the foot. The well-padded splint is secured first of all to the knee, the bandage being continued downwards to a few inches above the malleoli. Inversion is secured by a bandage which makes a figure of 8 turn from within outwards round the ankle and foot, and then is secured to the prongs at the lower end of the splint. The great drawback to Dupuytren's splint is that though it satisfactorily prevents eversion of the foot, it does not rectify the backward displacement or plantar flexion. This may be remedied by using in addition a Symes's horseshoe splint. This consists of an anterior splint, which rests against the front of the leg from the tubercle of the tibia, and ends below in two prongs, which extend one on each side of the foot. A loop of flannel attached on each side to the lateral prongs passes behind the heel, and so draws the foot forwards. When using this splint care must be taken to see that there is plenty of padding between it and the tibia, as a splint sore is otherwise very likely to result from its use. Dupuytren's splint may also be in combination with a MacIntyre to prevent backward displacement and plantar flexion.

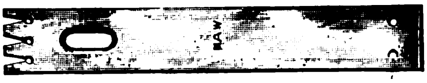


FIG. 16.—Dupuytren's Splint.

(v.) In many cases the deformity is of such a nature that satisfactory reduction is impossible by manipulation alone. In this case direct fixation of the fragments after an open operation should be undertaken in suitable cases.

In all cases massage and movements of the toes should be commenced at once. If back and side splints or Roughton's splint are used, this can be done by removing the side splints and bandage in the former case, and the internal splint in the latter, the fracture being thus still supported. By the seventh day the splints must be loosened so as to allow the commencement of cautious passive movements of the ankle-joint. At the end of three weeks a Croft's plaster splint is substituted for the wooden splints, and the patient is allowed to get about on crutches ; massage and movements are continued daily, and the patient may be allowed to walk at the end of the seventh week. A compound Pott's fracture is a very serious injury, as the ankle-joint is necessarily opened. The wound must be carefully cleansed and the fracture reduced. Should suppuration occur, amputation may be required.

(c) *Separation of the Lower Epiphysis of the Tibia.* — This injury takes the place of Pott's fracture in children. It is usually the result of excessive eversion of the foot. The ankle-joint is not necessarily involved, as the epiphysial line is situated above the level of the joint. The fibula is usually also fractured. The displacement closely resembles that of Pott's fracture. The deformity must be reduced under an anæsthetic, and the subsequent treatment will resemble that of Pott's fracture.

FRACTURES OF THE TARSAL BONES.

Fractures of the tarsal bones are usually the result of considerable direct violence, such as a fall on the feet from a height or from a heavy weight striking or passing over the foot.

The tarsal bones most likely to be fractured are the os calcis and the astragalus.

Fracture of the Os Calcis.—An anæsthetic must be administered, and the separated fragments manipulated into position. This can be more easily effected if the knee is flexed to relax the tendo Achillis.

Two lateral plaster splints are then applied, a thick pad being placed at the inner border of the foot to support the arch.

The patient is kept in bed with the knee still in the flexed position. This may be conveniently carried out by slinging the leg from a cradle. The splint is cut up, and massage and passive movements are commenced after the lapse of a few days.

There is considerable likelihood of some permanent disability resulting from this injury, especially a condition of *talipes valgus.* The patient may be allowed to walk at the end of eight weeks, but the arch must be supported for another month.

Fracture of the Astragalus.—If there is no displacement the leg may be placed on a back splint for a few days, and an ice-bag applied until the swelling subsides. A Croft's plaster splint may then be used, which is cut up on the following day, when massage and passive movements are commenced. When the neck of the bone is fractured the foot is displaced and the small fragment moves with it. Reduction may be effected by administering an anæsthetic and manipulating the foot. Treatment will then be as described above. Walking should not be allowed in either case until eight weeks after the accident.

When the fracture is comminuted the fragments may be so widely displaced that no attempt at reduction is likely to be successful. Under these circumstances the best result is likely to be obtained by an open operation for excising the fractured fragments.

The remaining tarsal bones may occasionally be fractured, usually as the result of a severe crush. Several bones are likely to be broken, and the injury will probably be compound.

The treatment in this condition will be that of the crushed foot rather than of fracture of the individual bones, and the usual question for discussion is whether primary amputation is desirable, or whether conservative treatment is likely to result in a useful foot.

FRACTURE OF THE METATARSALS.

The metatarsals may be fractured as the result of direct violence, such as a cart-wheel passing over the foot.

The patient should be kept in bed for a few days with the foot on a splint. Evaporating lotions should be applied to reduce the swelling. Massage may be commenced on the third day, and a plaster splint may then be applied and the patient allowed to get about on crutches.

Union is complete in about four weeks, when the patient may be allowed to walk.

PHILIP TURNER.

THE OPERATIVE TREATMENT OF FRACTURES.

I WAS originally led to resort to operative procedures in the treatment of simple fractures by finding, from the dissection of bodies whose bones had sustained fractures, that the fragments when displaced had hardly ever united in anything approaching accurate apposition, and that definite changes took place in those joints whose functions were affected by the alteration in the physiology of the skeleton resulting from such imperfect replacement of the broken fragments. These changes varied with the age of the individual, and I called the condition mechanical or traumatic arthritis.

A careful enquiry into the results of the treatment of fractures by splints and manipulation confirmed the experiences of the dissecting-room, and showed that the consequent joint changes meant depreciation in physique and the wage-earning capacity of those who had to engage in laborious pursuits. These views met with violent opposition till the discovery of X-rays proved that the first contention was true, while the law courts in this country and in the United States are steadily impressing on the profession, in a costly manner, the disabilities which are associated with imperfect restoration in the form of broken bones.

In 1894 I read before the Clinical Society of London my first paper on the results of the treatment of simple fractures by operation, and I contrasted them with those obtained by other means. Since that time I continued to operate on all simple fractures in which I was unable to bring the fragments into satisfactory apposition when the circumstances of the patient required it.

Operative measures offer to the patient the following advantages:

(*a*) They at once relieve him from the pain of any movement of the fragments upon one another.

(*b*) They free him from the tension and discomfort due to the extensive extravasation of blood between and into the tissues.

(*c*) They shorten the duration of the period during which he is incapacitated from work, since union is practically by first intention, and, consequently, very rapid and perfect.

(*d*) Lastly, and by far the most important, they leave his skeletal mechanics in the condition in which they were before he sustained the injury.

During the last seventeen years I have operated upon a very large number of recent fractures at all ages, from early infancy to extreme old age, with the same uniform success. I have employed various methods at different times, endeavouring to devise means of fixation of the fragments in accurate apposition which shall be at the same time effectual and easy of application. I soon recognised that if the treatment by open operation was to become general it was necessary that the procedure should be rendered as uncomplicated as possible.

The difficulty which has beset this treatment is that, if a foreign body is left in a wound, the surgeon must be infinitely more careful about asepsis than he is in the ordinary course of events, and careful in a degree proportionate to the bulk of the foreign body. It is because of insufficient aseptic precautions and to some extent from a want of familiarity with the use of wire, screws, etc., that we hear of so many complaints of the development of rarefying osteitis about a screw or wire perforating a bone, of screws working loose and consequently becoming ineffective for the purpose for which they were employed, and of the employment of such futile means as ivory pegs, etc.

With the exercise of greater cleanliness and with an increasing manual dexterity these troubles will cease to arise. Why a surgeon should not be governed by the same principles by which an ordinary skilled mechanic works I cannot understand, but I presume that the surgeon has rarely had any such training as would fit him for this kind of work. Curiously enough, the opposition to operative procedures which continued with such intensity for so long seems to have suddenly diminished, because several surgeons have broken loose from tradition and have satisfied themselves that by operation alone can the greatest measure of success be obtained.

I do not propose to discuss the various methods I have adopted for retaining the fragments immovably in accurate apposition, but will confine myself to describing those which I now find most effective for the purpose.

In deciding as to whether the surgeon should operate upon any particular fracture, or whether he should be satisfied to treat the case by manipulation, splints, massage, active and passive movements, etc., the importance or not of restoring the fractured bone or bones to their normal form should be the guide. It is obvious that if there is no displacement of fragments, or if the displacement can be overcome by manipulation, etc., no operation is required in the ordinary case. Till surgeons generally have improved their technique sufficiently, and have acquired a greater familiarity with the operative treatment of fractures, a varying degree of risk must necessarily accompany any open operation, and this danger has to be taken into consideration. It is necessary that an asepsis must be observed which is far superior to that requisite for other operations, because a considerable quantity of metal is left in the wound. Again, these operations may be very difficult to perform, and those assisting the surgeon require special knowledge and experience. However, if the surgeon is careful and familiar with these operations, and his assistants are efficient and reliable, there is practically no risk in the operation, and, unless the bone is too thin, too soft, or too much comminuted, he ought to be able to obtain a perfect result anatomically and functionally.

The surgeon must remember that the result of his treatment, whether operative or not, will probably be submitted to the test of radiography, and that a jury, instructed by counsel whom our own creed teaches that the surgeon who has not placed the fragments in accurate apposition has not performed his work properly, are likely to regard any marked irregularity in the form of the bone as indicating a want of sufficient skill on the part of the surgeon, especially if such anatomical defect is associated with a marked loss of function. He must, therefore, be most careful in having fractures carefully X-rayed in planes crossing each other at right angles, so that any displacement may not escape his observation. A photograph of a single plane is insufficient in the case of the long bones, however good it is. The details of the photograph should be carefully and clearly explained to the patient and to friends, and, whatever course of treatment is decided on, it would be advisable to obtain a written and witnessed acquiescence, so as to secure the medical attendant from subsequent loss, annoyance and anxiety. To trust entirely to the now practically obsolete symptom called crepitus, and to an imaginary familiarity with the other clinical symptoms of fracture, is absurd in the present day, when every detail of any importance can be learnt by means of radiography, which is perfectly reliable in competent hands. In any case, the surgeon who does not insist on efficient radiograms being taken at the earliest moment in any suspicious case of injury renders himself liable to much criticism and financial loss in the future.

To ensure success in the operative treatment of simple fractures it is necessary to have an asepsis which must be perfect. Any failure in asepsis may result in more or less serious consequences to the patient. A virulent infection may result in loss of the limb or even of the life of the patient.

If the infection be of a mild character a process of inflammation takes place about each of the screws, resulting in their being loosened and subsequently extruded, or the bone for an area of a variable extent about the screws may necrose, when the sequestrum and screws are forced out by an inflammatory process around the dead area of bone encircling the screws. Infection of the wound does not necessarily demand removal of the plate and screws. A vaccine obtained from the organisms may cause their destruction and the wound may heal.

In consequence of failure of asepsis non-union of the fragments frequently results. This condition of non-union consequent on infection of the wound is of a very serious nature, since the organisms producing the infection lie dormant in and about the ununited fracture, too frequently lighting up at once into activity should the surgeon attempt on a subsequent occasion to excise the surfaces of bone forming the ununited fracture and to unite the ends of the fragments by means of screws and plates.

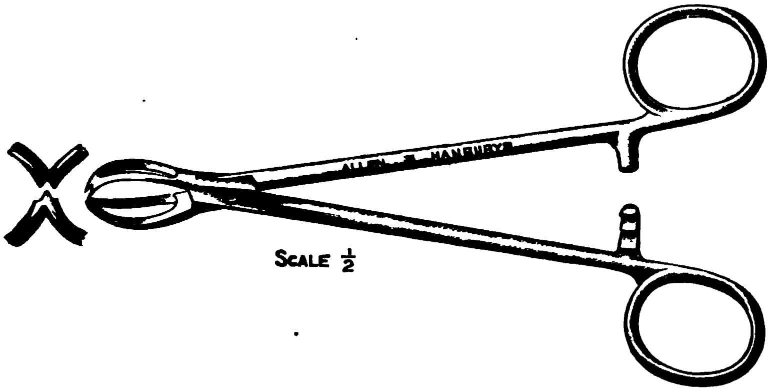


FIG. 1.

Therefore, both from the point of view of immediate risk and of subsequent mechanical disability, it is of vital importance to ensure asepsis.

The technique to be observed is as follows:

The skin of the patient for a considerable area around the seat of fracture must be rendered as sterile as possible. Even after the most elaborate precautions the skin adjacent to the incision must not be allowed to come in contact with the wound or with any of the apparatus employed at the operation. In fractures of the arm and leg the skin of the entire extremity should be treated in this manner. In the case of the young child or in a clean subject this can be done very quickly, but in fractures occurring in labourers, and especially those in the vicinity of the foot, it is necessary to soak the parts for several days before the operation in order that the thick layer of surface epithelium may be removed by frequent scrapings and washings. The germicide employed for the purpose of cleaning the skin will probably vary with the particular surgeon. Personally, I prefer biniodide of mercury in methylated spirit and tincture of iodine.

The locality of the incision should be carefully chosen, to avoid damage to important structures and especially to nerves, and to reduce to a minimum the chance of subsequent infection of the wound. In the lower extremity there is no risk to important vessels, tendons or nerves, but in the arm the conditions are very different, and every precaution must be taken.

To ensure asepsis, which one can do with certainty, an incision of ample length is made. Several folds of gauze are attached to the edges of the skin incision by means of fenestrated forceps specially constructed for the purpose. They are long and heavy enough to fall away from the wound and do not require to be held (*see* Fig. 1).

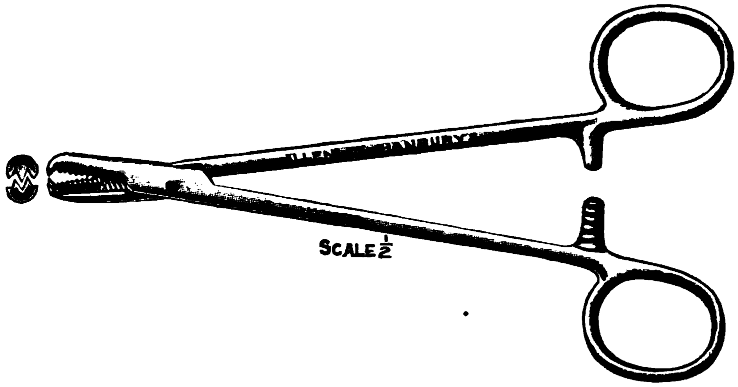


FIG. 2.

The forceps used to control hæmorrhage exert pressure upon the bleeding vessels sufficient to permanently obliterate their lumen. By their use the necessity of the introduction of the gloved hand into the wound for the purpose of tying a ligature is avoided (Fig. 2). The danger of the rubber glove is the possible presence of a puncture through which infection might enter the wound. The hæmostatic forceps are very long, so that the handles fall free of the wound.

All instruments employed for manipulating fragments, holding swabs, plates and screws, for drilling bones and driving in screws are also very long and very powerful, in order to avoid any contact with the wound of the portion of the instrument grasped by the hand, since the gloves are liable to be damaged in the powerful manual efforts which are sometimes necessary to restore the broken bone to its original form.

In considering the means by which **accurate apposition of fragments** are effected, we must take into account the nature of the fracture and whether one or two bones are involved. Besides this, comminution often adds greatly to the difficulty of the operation.

Anyone who is imbued with the old creed and unfamiliar with operations on recent fractures would imagine that to effect apposition all that is necessary is to exert traction upon the distal fragment of the broken bone by pulling on the limb, the trunk being secured, and that by means of this traction the fragments can be drawn from their beds in the soft parts and the fractured surfaces placed in accurate contact.

In the case of spiral fractures of the long bones of the lower extremity (in which this variety of fracture is the most common) no amount of traction which can be exerted on the limb is sufficient to overcome the over-riding of the fragments. This is due to the resistance offered by the bruised and swollen soft parts which surround the fractured bone, and from the point of view of traction on the limb form inextensible ties in its length. This applies particularly to fractures produced by direct injury, the resistance to replacement varying with the extent of overlapping of the fragments, the amount of extravasation of blood, the laceration of soft parts and the consequent inflammation, which are all greater in direct than indirect fractures.

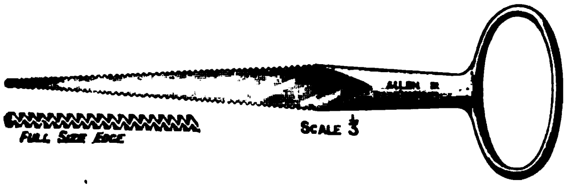


FIG. 3.

To effect apposition in spiral fractures it is necessary to divide or displace all soft parts intervening between the fragments, to carefully clean away any clot or soft tissues from the fractured surfaces and especially from the retreating angles of the fragments, and to exert traction on the limb, supplementing that traction by forcible apposition of the fragments by powerful forceps, which are so manipulated as to glide the inclined plane of one fragment upon the other. This gliding of the fragments is facilitated by the introduction of a narrow flat blade with a serrated edge to prevent it slipping between the fragments. This, when rotated upon its axis, by its powerful leverage action moves the fragments held together by the forceps upon one another (Fig. 3).

In the case of a fracture of a single bone, as the femur, which has been broken by direct injury, the extent of the overlapping of the fragments is from the nature of the injury and the mode of causation of the fracture usually much less. Still, the damage sustained by the surrounding soft parts or ties in the length is correspondingly greater, since in the torsion fracture the injury which the muscles sustain results solely from the fracture, while in that produced by direct injury the soft parts are lacerated and bruised by the impact of the force which determined the fracture, and only to a small extent from the forcible displacement and overlapping of the fragments.

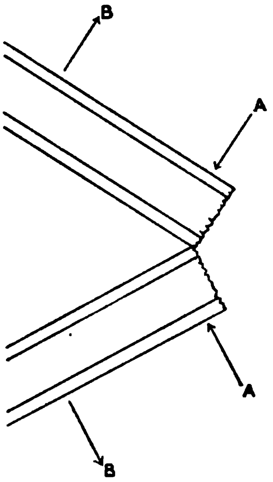


FIG. 4.

In a fracture of the femur produced by direct injury, traction alone exerted on the limb does not appear to influence the over-riding of the fragments. The fragments can most readily be brought into apposition by so manipulating the limb that the extremities of both are made to protrude through the incision, and can be manipulated till the inner margins of the fractured surfaces are brought in contact with one another. Each fragment is grasped with forceps, and while the limb is slowly and steadily extended the opposing edges of the ends of the fragments are levered on one another till the broken surfaces come into accurate apposition, when the axes of the fragments are in continuity and the bone is restored to its normal form (*see* Fig. 4).

This difficulty does not exist to the same extent in fractures of the upper extremity produced by direct injury, since the ties in this limb are less bulky and tense than in the leg, and, from the nature of things, spiral or torsion fractures are of comparatively rare occurrence in the humerus, radius or ulna, though they are not infrequent in the metacarpals.

The difficulty of effecting accurate apposition is very greatly increased by the presence of comminution, which can make a considerable demand on the skill and ingenuity of the surgeon. This

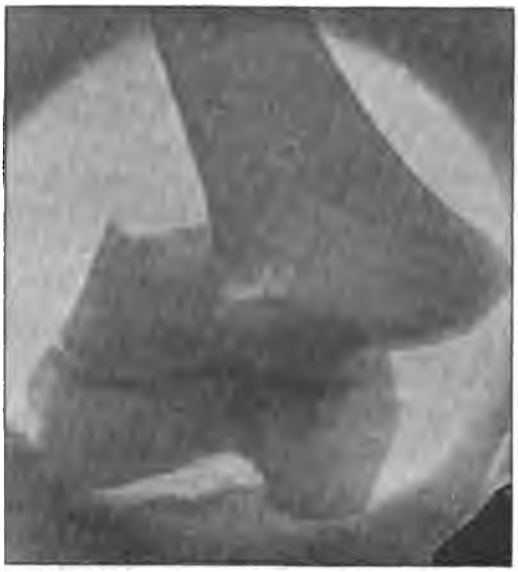


FIG. 5.

complication produces most obstacles in the case of the spiral fractures, since every aspect of the fragments is very oblique and much

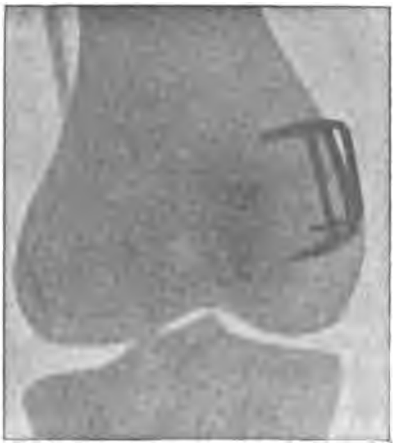


FIG. 6.

is necessarily out of sight, and there is no surface or point on which one fragment may be made to pivot or impact on the other.

Perhaps the most awkward complications one may have to meet are fragility of the fragments, such as appears to exist to a great extent in alcoholics, and to a lesser degree in feeble children and in old age, and the softness of the bones in rickets. But this concerns the retention of the fragments in apposition rather than their reduction.

Delay in operating renders the replacement of the fragments more difficult, because the shortened soft parts or ties become rapidly less extensible and a correspondingly greater force is required to stretch them. This is a serious matter if the bones are fragile or comminuted. Again, the ends of the fractured bone and especially the distal fragments undergo a process of rarefaction which is very rapid and very marked in early life. The rate of rarefaction varies inversely as the age of the patient, but progresses out of all proportion in the first few days or weeks of life. This rarefaction means an insecure hold for the screws, and must be taken into serious consideration. The operation should be undertaken as soon as the skin can be effectually cleansed.

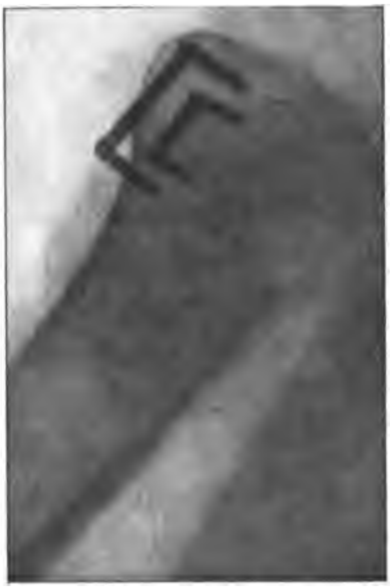


FIG. 7.

As to **the best means of retaining fragments securely in apposition** when the fractured bone has been restored to its normal form, I would point out that in certain fractures, as in those about epiphysial lines, there is usually no tendency to a recurrence of the displacement once reduction has been effected, providing the part is put up in a position the reverse of that in which the fracture was produced. For instance, in a Colles's fracture either through bone or through the junction of the shaft with the epiphysial line, after replacement of the fragment by manipulation or operation the hand is retained in a position of extreme flexion and adduction, which is also the extreme position of usefulness. It is well to remember that if the surgeon has to employ any means for retaining an epiphysis in position, as, for example, in separation of the lower epiphysis of the femur, he should insist on the removal of the rigid connecting medium after union has been effected, otherwise it will control the growth in the epiphysial line and deformity will result. In a case of a complicated fracture through the inner half of the epiphysial line of the lower end of the femur, objection was made to the removal of the staples which were employed to retain the fragment in position because of the condition of the patient. Later this patient developed a bowed leg.

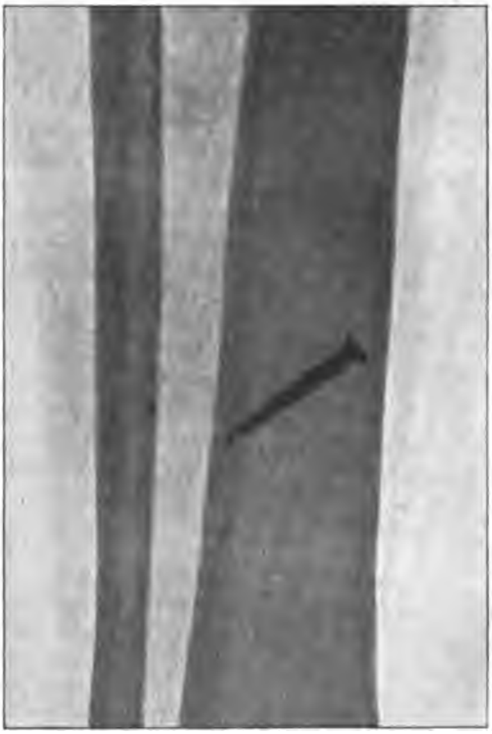


FIG. 8.

Figs. 5 and 6 represent the case of separated epiphysis referred to. Fig. 7 shows the fixation of fragments of the upper end of the humerus by staples. The circumstances were such that screws and a plate would not have retained the fragments in apposition with the same security as the staples.

There are occasions on which it is necessary to rely on screws alone, as in the case of fractures of the neck of the femur and in some spiral fractures, but in the vast majority of cases I prefer to use *as long and as strong a steel plate as possible, carrying as many screws as space permits.* To reduce the difficulty of finding the drill hole in the distal compact layer of bone, which is frequently of no avail when the fragment is comminuted, I employ screws of a length only sufficient to engage the proximal compact tissue, and

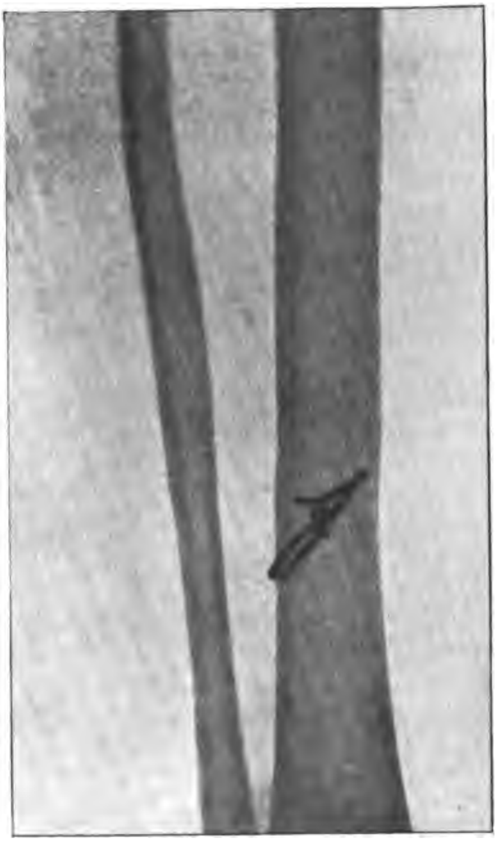


FIG. 9.

threaded up to the head in order to secure as firm a hold as possible on the bone.

That screws and wire can afford efficient means for securing fragments in apposition is well shown by Fig. 8, which represents a recent spiral fracture of the tibia and fibula. In the radiogram no indication of the fracture can be observed, so accurate is the apposition.

Fig. 9 shows a spiral fracture of the tibia and fibula precisely similar in type, in which the fragments were secured by a single loop of wire. In this radiogram the line of apposition of fragments can be seen distinctly.

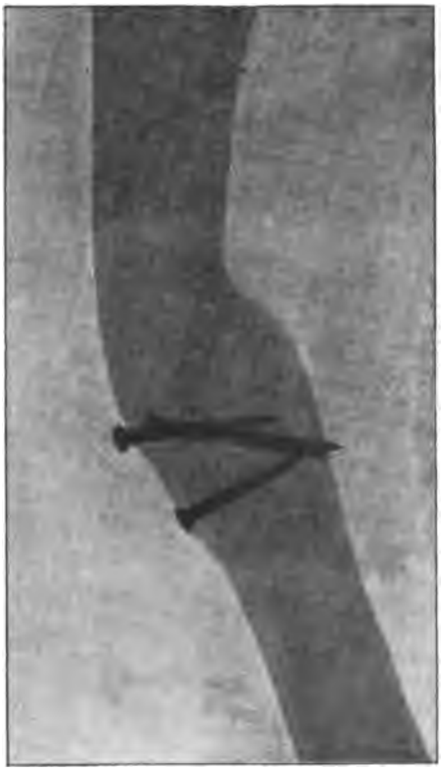


FIG. 10.

Fig. 10 shows the result of operation on a badly united fracture of the femur, in which the fragments overlapped at an angle only a little larger than a right angle.

Figs. 11, 12, and 13 show fractures of the radius and ulna in which the fragments have been secured by wire.

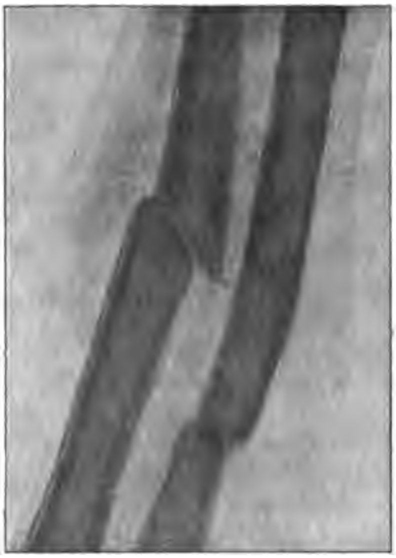


FIG. 11.

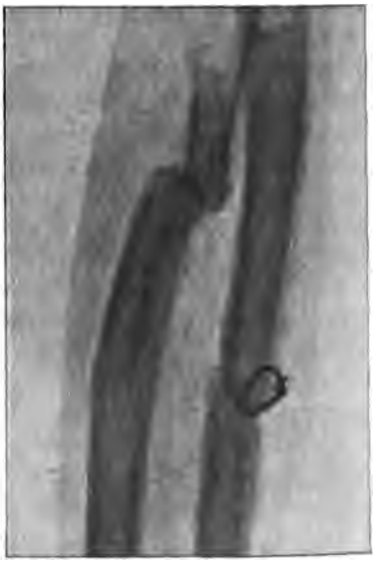


FIG. 12.

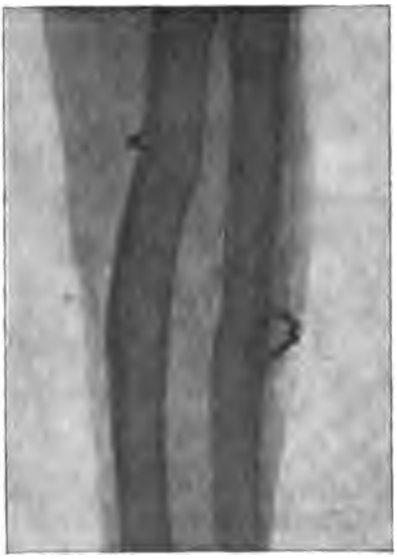


FIG. 13.

After the fragments have been placed in perfect apposition they are held securely by means of long powerful forceps to prevent any alteration in their relationship to one another while the holes are being drilled and the screws driven home. The plate is then placed in the most suitable position. As a rule the longer the plate employed and the more numerous the screws used, the less likely is the operation to fail in securing perfect alignment of the fragments. When the broken bone lies immediately beneath the skin, the surgeon should, if possible, put his plate on the surface of bone which is covered by muscle, and so avoid, if possible, any irritation of the skin by the bulk of the plate. In many cases it may be wise to insert a plate into the bone where it lies beneath the skin, in order to facilitate the subsequent introduction of a plate on its muscle-covered aspect. When the second plate has been securely fixed, the first one can be removed. There are, however, many fractures, as those with excessive abduction and adduction of the foot, in which the plate must necessarily be subcutaneous. In such cases the use of thin plates, carefully shaped to fit the bony surfaces accurately, and the accurate introduction of the screw in a plane which will leave little or no projection of the head, is the best means of meeting the difficulty.

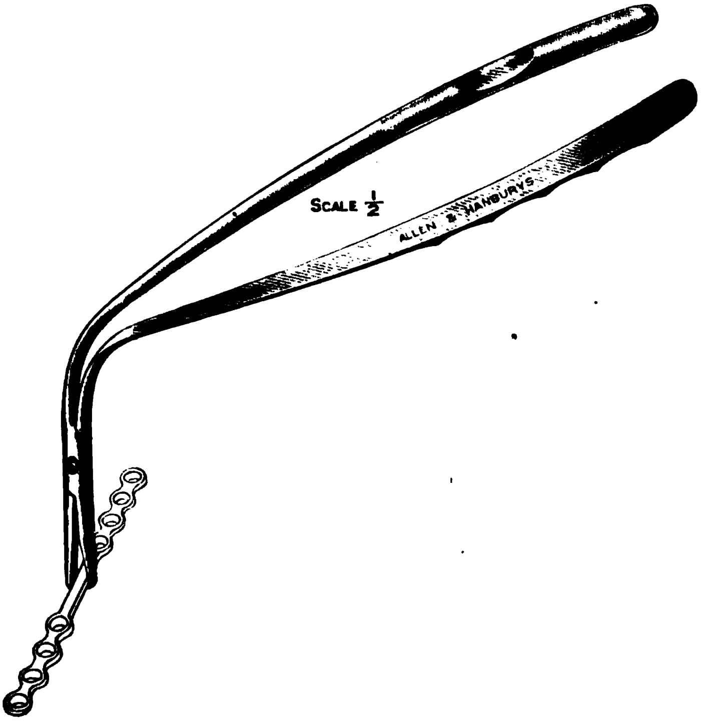


FIG. 14.

In fractures of the olecranon and of the patella the same trouble must be taken. If after the fragments have united firmly the plate causes any annoyance to the patients, it can readily be removed, but in my experience this is rarely requisite.

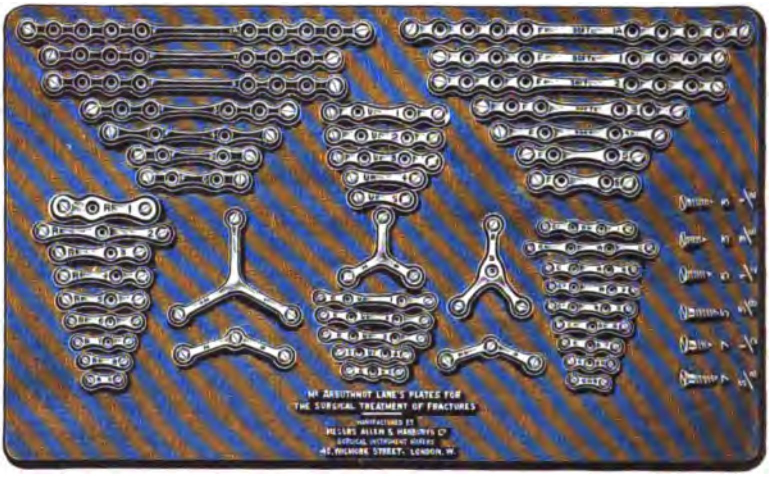

MR ARBUTHNOT LANE'S PLATES FOR
THE SURGICAL TREATMENT OF FRACTURES
MANUFACTURED BY
MESSRS ALLEN & HANBURYS LD
SURGICAL INSTRUMENT MAKERS
48 WIGMORE STREET, LONDON, W.

FIG. 15.

Where the bone is well covered by muscle, as in the case of the femur, no difficulty arises.

The plate should certainly be long enough to hold the fragments with complete security and in a condition of absolute immobilisation. It should be bent, if necessary, so as to fit the surface of the bone accurately, in order to avoid any such strain on the screws as would result from the forcible adaptation of the plate to the form of the bone by screw pressure. This pressure may be requisite in operations done for malunited fractures, but it is never called for in recent fractures.

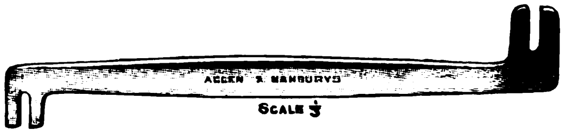


FIG. 16.

This plate is held in a pair of forceps specially constructed for the purpose (*see* Fig. 14). These forceps are so shaped as not to interfere with the use of the drill and screws.

The plates are of various forms and thicknesses, and those in common use are shown on Fig. 15. And this illustration also represents the screws which are most generally useful in these cases.

Fig. 16 shows the wrench used for bending the stouter plates.

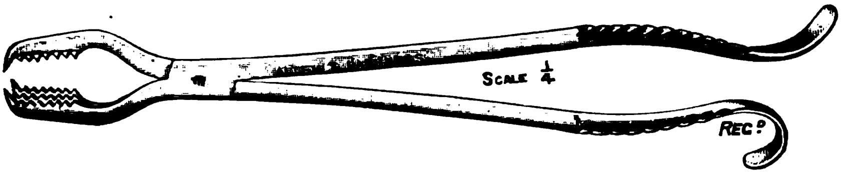


FIG. 17.

The screws commonly employed with these plates are in three gauges—3, 5, and 7—and are threaded up to the head. The sizes are $\frac{3}{8}$ and $\frac{1}{2}$ inch in No. 3 gauge, and $\frac{1}{2}$ and $\frac{5}{8}$ inch in Nos. 5 and 7 gauges.

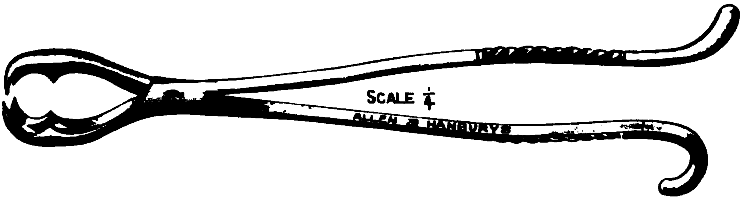


FIG. 18.

The object of using a short screw is to employ only the proximal compact osseous tissue in the adult, so avoiding the larger screw which engages only the distal compact tissue: this materially facilitates the introduction of the screw and reduces considerably the bulk of metal introduced without diminishing the security of the grip of the screw.

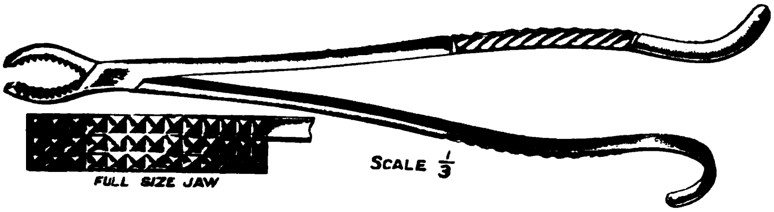


FIG. 19.

For the screw threaded to the head only one drill is required, whereas in the ordinary screw, the barrel being larger than the thread, the hole in the proximal compact layer of bone must be made larger than that in the distal one. The fewer the varieties of screws employed the smaller is the number of drills, and consequently the less complicated the operation, since each gauge of these modified screws requires only one drill. By this means I have reduced enormously the difficulties of securing the fragments immovably in apposition.

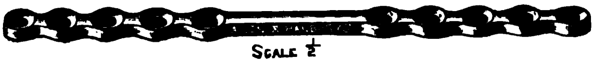


Fig. 20.

In simple fractures I hardly ever use wire. I would exclude from this the fractures of infancy when two or more weeks have been allowed to elapse between the receipt of the injury and the operation. In such cases the distal fragment loses its density at a very early period, and while the proximal fragment will hold the screw securely, the thread will get no secure grip of the distal portion because of its friability. In these circumstances I supplement the junction by encircling the plate and distal fragment with a loop of silver wire.

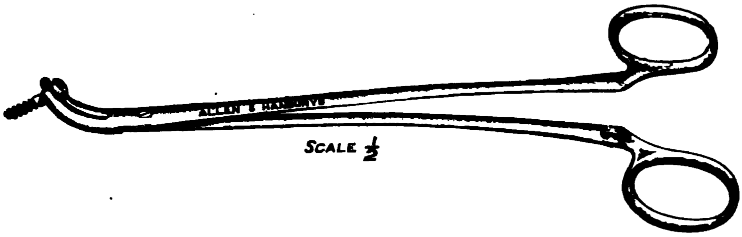


Fig. 21.

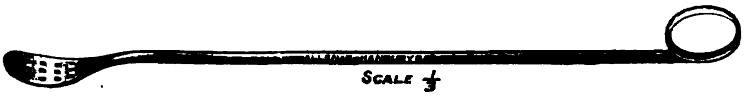


Fig. 22.

The operative measures which are required in the **treatment of badly united fractures** are similar, except that the fragments have to be cut through in two distinct planes in fracture of a single bone and in four planes in fracture of two bones, such as the radius and ulna or tibia and fibula, in order that the axes of the fragments can be rendered continuous. These operations are very much more difficult and are accompanied with more risk from hæmorrhage than are recent fractures. The results obtained are also very rarely as good, because of the changes which develop in the joints whose functions have been affected by the faulty junction. I think that with better initial treatment such cases will soon cease to exist.

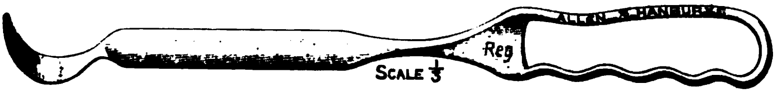


FIG. 23.

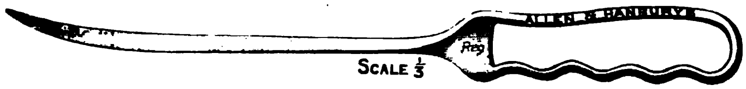


FIG. 24.

Whatever the extent of the shortening in badly united fractures, the surgeon should endeavour to correct it entirely or to reduce it as much as possible. There is, as far as I am aware, no limit to which the muscles, nerves, vessels, etc., can be stretched if only sufficient force can be exerted on the fragments. Such operations may make a very great demand on the skill and resources of the surgeon, and an increasing familiarity with them will enable him to obtain an increased measure of success.

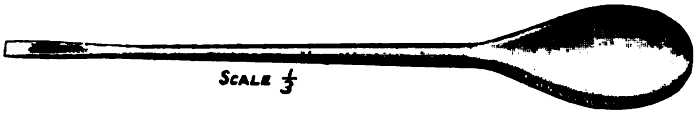


FIG. 25.

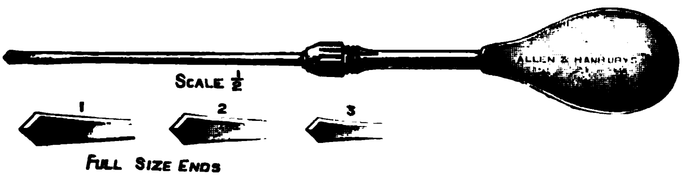


FIG. 26.

Figs. 17 to 26 represent the instruments which are required for these operations. Fig. 21 shows the forceps in which the screw is held in order to facilitate its introduction. Figs. 22, 23, and 24 show the retractors which are passed beneath the fragments, and, thrusting aside the soft parts, facilitate very materially the performance of this operation. Fig. 25 represents a useful screw-driver, which can also be used as an elevator. Fig. 26 shows the several drills (numbered 5 and 3, according to the three gauges) and holder.

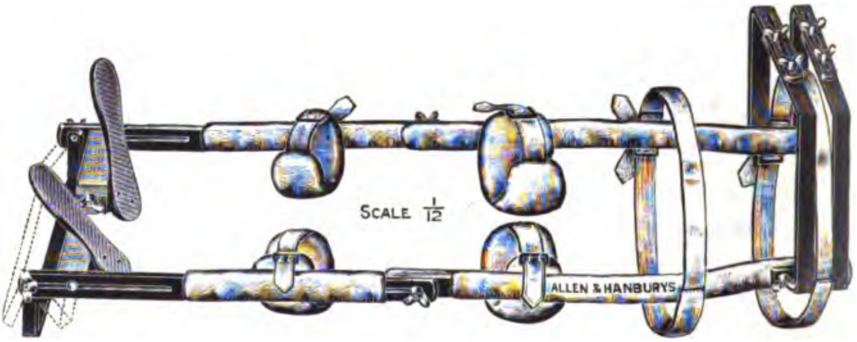


FIG. 27.

Not the least difficult nor the least important part of the operation is the the closure of the wound. The edges of the skin incision must be brought accurately together and must be retained very securely in apposition, since any separation of the edges of the skin may result in infection of the wound. For this purpose Michel's clips are found to be most effectual. When there is no tension they are introduced easily, but where there is much swelling and inflammation their fixation is a matter of the greatest

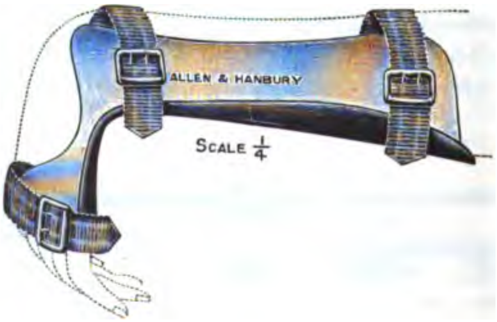


FIG. 28.

difficulty. In such cases it can only be accomplished by securing accurate co-aptation, by means of specially constructed tenaculum forceps introduced closely together. The clips are then fixed near

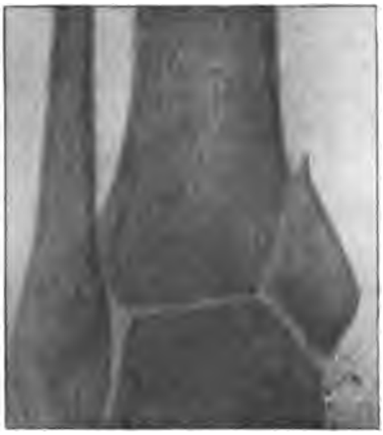


FIG. 29.

one another in the intervals between the forceps, and when they have all been attached the strain upon them is so evenly distributed that the forceps can be safely removed without any separation of the edges of the incision.

Most fractures which have been operated on are best treated by means of a splint, which should be of such a nature as to avoid strain on the junction, while it should permit, if possible, the movement of the joints about the fractured bone, and so avoid a stiffness which may give a great deal of trouble after firm union of the broken bone has been effected.

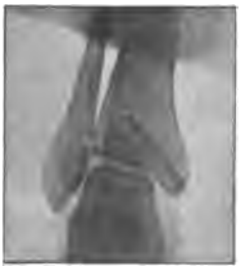


FIG. 30.

In fracture of the femur in the adult one of the most troublesome complications is the stiffness and fixation of the knee-joint which follows upon the retention of this joint for some weeks in the extended position. Mr. Harold Chapple has devised an ingenious apparatus to meet this difficulty effectually. By means of lateral steel rods and supports the broken bone is held securely and comfortably, while by an arrangement of screws the knees may be bent completely daily and any risk of stiffness avoided (Fig. 27).

I would strongly recommend this splint to the surgeon who is operating in a case of fractured femur in the adult.

In a large number of fractures, as in Colles's fracture and in fracture of the lower end of the humerus in the young subject, when the fragment has been replaced in perfect apposition either by manipulation, which is usually sufficient in the former condition, or by open operation, which is generally preferable in the latter injury, the fixation of the joint in a position of extreme flexion will obviate any tendency to the displacement of the broken fragments.

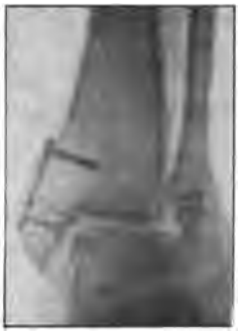


FIG. 31.

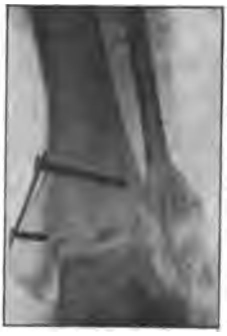


FIG. 32.

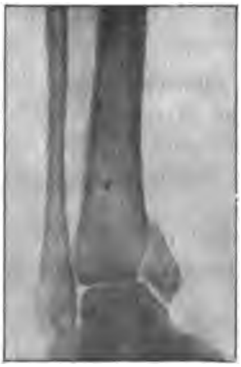


FIG. 33.

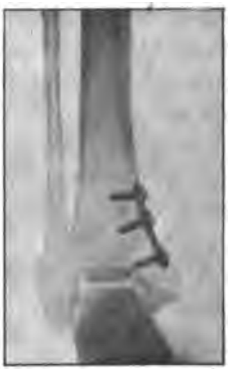


FIG. 34.

Fig. 28 represents a splint I devised for Colles's fracture after the fragments have been replaced in accurate apposition as verified by a radiogram. The wrist is retained in a position of extreme flexion and adduction. The movement of the thumb and fingers is not controlled by its use.

In order to illustrate to the greatest advantage the operative measures requisite in each particular fracture, the following radiograms showing the conditions before and after operation will demonstrate the obstacles to the accurate reduction of fragments and the mode by which they are secured once accurate apposition has been effected.

The fractures which result from excessive forcible adduction of the foot are of two degrees of severity:

In the first the inner malleolus and a portion of the tibia are broken more or less vertically from the rest of the shaft by the direct inward thrust of the astragalus on the inner malleolus (Fig. 29). In the second the fibula is broken transversely by the strain exerted upon the external malleolus by the external lateral ligament when the internal malleolus has given way.

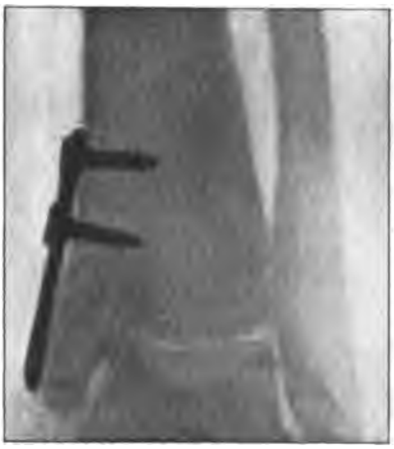


FIG. 35.

The fracture of the fibula takes place where the fibula lies on the sharp lower and outer edge of the tibia and is irregular in form, being of the nature of a scrunch fracture. To meet either of these fractures an incision is made vertically over the inner malleolus, and the fragment including the malleolus is forced by pressure into accurate apposition with the tibia. It is retained in this position by means of a single long screw as in Fig. 30.

Note the fracture of the fibula and the practically accurate apposition of its fragments that results from a perfect restoration of the tibial fragments.

Or the inner malleolus may be fixed by a plate and two screws as in Figs. 31 and 32. In these the fibula has also been broken and comminuted.

In Figs. 33 and 34, in which the tibia only has been broken, a plate with three screws was effectual in retaining the fragment in position.

In Fig. 35 it was not found necessary to secure the lower fragment with a screw, since it was retained sufficiently securely in position by means of the plate.

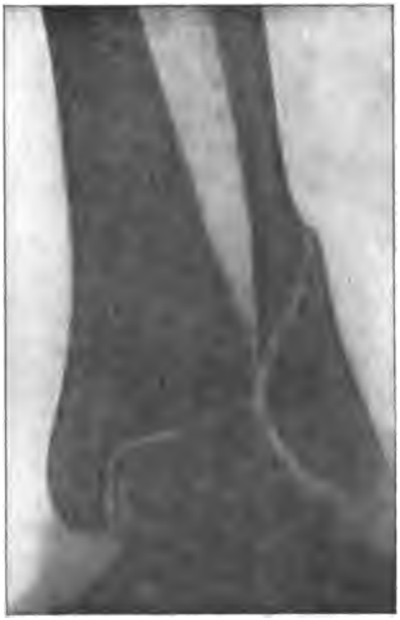


FIG. 36.

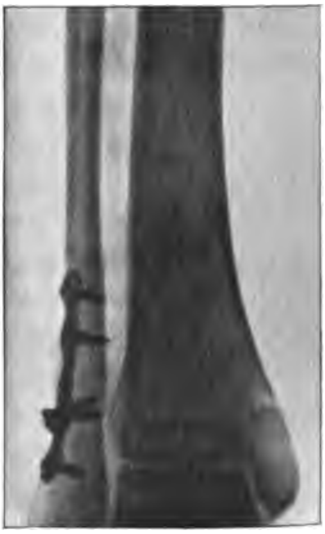


FIG. 37.

The fractures which result from excessive forcible abduction are of three degrees of severity. In the first the fibula is broken by torsion, and consequently, spirally or vertically, by the thrust of the anterior portion of the astragaloid facet on the corresponding part of the external malleolus. In the second the inner malleolus is broken transversely by the strain exerted upon it through the internal lateral ligament after the fibula has given way. In the third a portion of the outer and back part of the tibia which is connected to the fibula by the inferior inter-osseous ligament is broken off and displaced with the fibular fragment.

Fig. 36 shows the spiral fracture of the fibula, and Fig. 37 the result of operative interference.

Figs. 38 and 39 shows a spiral comminuted fracture of the fibula and a transverse fracture of the internal malleolus. The fragments have been accurately restored and secured by a plate and four screws, which traverse the fibula.

Figs. 40, 41 and 42 show the abduction fracture in the third degree of severity, the fibular, inner malleolar, and tibial fractures being all clearly shown. The fragments have been restored to their normal relationship, and have been secured by plates and screws engaging the fibula only.

Figs. 43 and 44 show the third degree of abduction fracture and the result of operative treatment. In this case, as is usual, only a single steel plate was requisite to retain all the fragments securely in apposition.

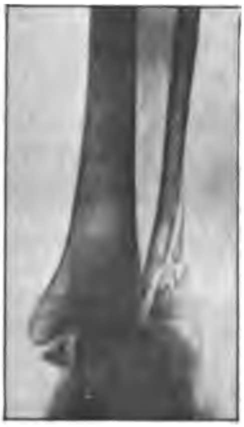


FIG. 38.

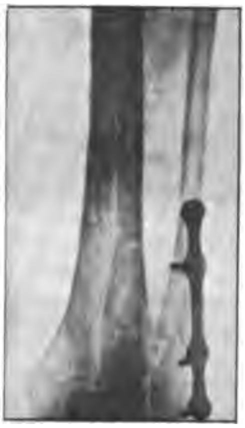


FIG. 39.

In abduction fractures a long incision is made over the fracture of the fibula, and when the fragments of this bone have been placed in accurate apposition the surgeon can be quite certain that the inner malleolar and the tibial fragments are in the best position possible. A single strong thin plate is sufficient, in the large majority of cases, to retain the fragments in their normal position.

Torsion, or spiral fracture of the tibia, or of the tibia and fibula, which are always produced by indirect violence, resemble each other very closely. The lower fragment of the tibia is driven upwards, backwards and outwards, while the upper fragment is driven downwards, forwards and inwards.

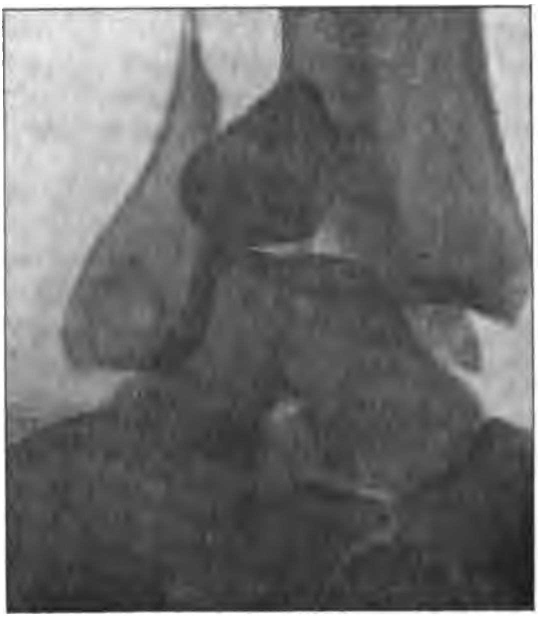


FIG. 40.

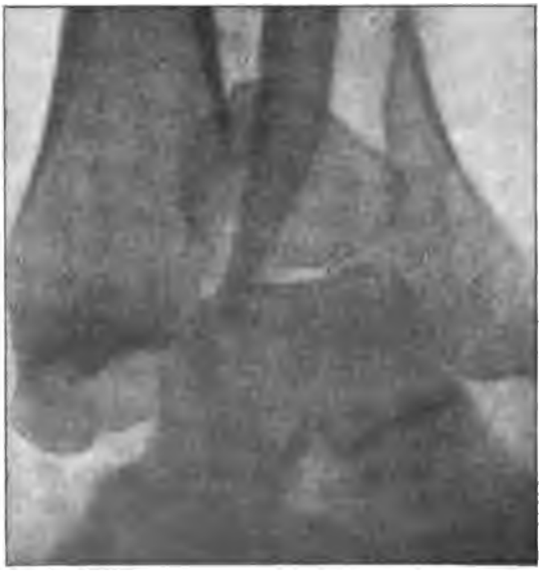


FIG. 41.

The fracture of the fibula, if present, affects that bone near its upper limit.

The accurate restoration of the tibial fragments is generally accompanied by the restoration of the fibula to its normal form; but should this not be the case, any lateral deviation at such a distance from the malleolus does not affect prejudicially the grip of this bone on the astragalus. On this ground it is hardly ever necessary to expose the fibular fracture in this type of injury.

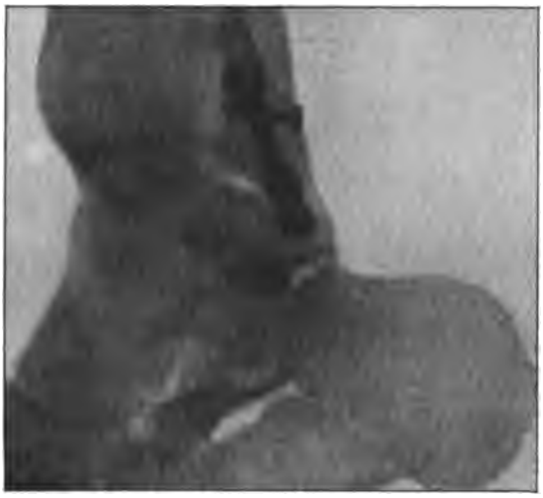


FIG. 42.

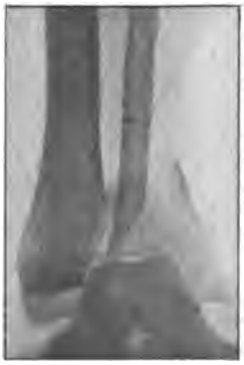


FIG. 43.

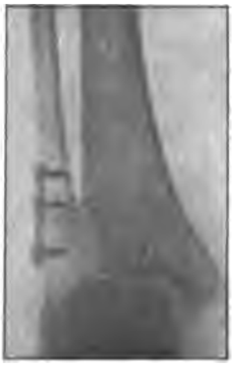


FIG. 44.

Every effort should be made to use thin plates, to bury the screw heads in the plate, and if possible to place the plate beneath a muscle covering, not immediately under the skin, in order to avoid irritation by pressure of a boot, etc., upon it.

In some cases the fragments may be temporarily retained by a subcutaneous plate till one can be introduced on the outer aspect of the bone. The plate which was first attached is then removed.

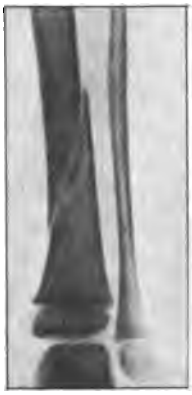


FIG. 45.

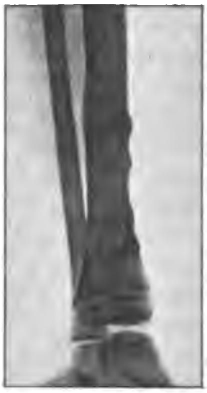


FIG. 46.

Figs. 45 and 46 show the spiral fracture of the tibia both before and after operation.

Figs. 47 and 48 show the same type of fracture with the vertical fissuring of the lower fragments which frequently complicates this injury. The mode of dealing with the comminution by an additional plate is illustrated here.

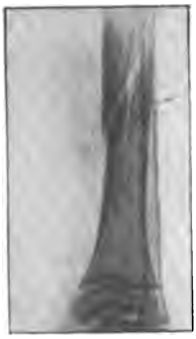


FIG. 47.

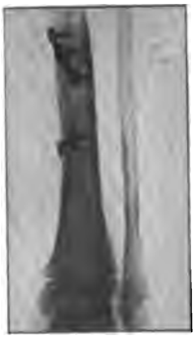


FIG. 48.

Figs. 49 and 50 represent another case of comminuted torsion fracture of the tibia. The fibular fracture is beyond the limit of the

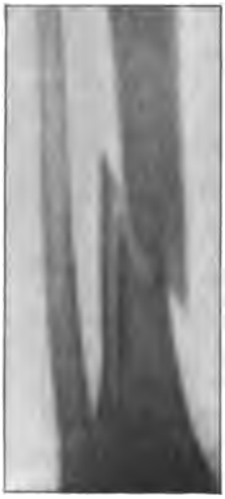


FIG. 49.

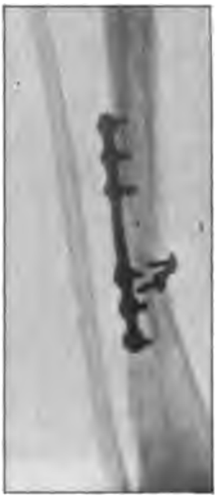


FIG. 50.

photographer. In this case a large stout plate was employed on the outer aspect of the tibia, while a small thin one was used on the inner aspect.

Figs. 51 and 52 show a spiral fracture of the tibia and fibula, the damage to the latter being just below its head. In this case, owing to the direction of the fracture, it was not found possible to place the plate on the outer aspect of the bone, but a thin plate was

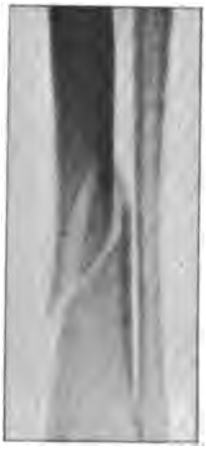


FIG. 51.

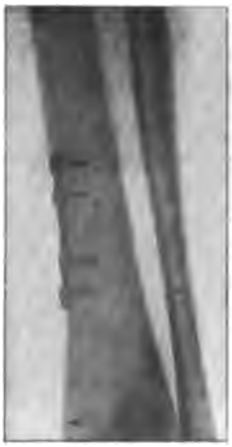
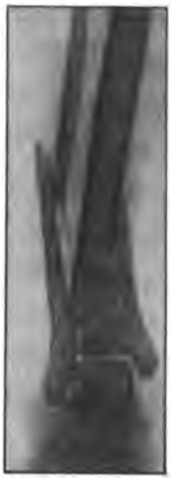


FIG. 52.



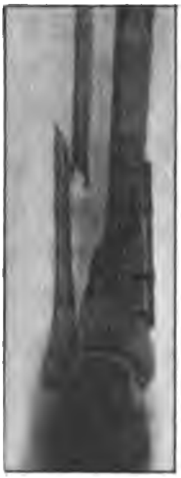
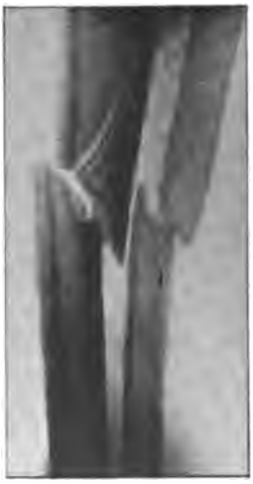


FIG. 53. FIG. 54.

placed on the inner surface so as to render it as inappreciable as possible from the point of view of pressure.

Figs. 53 and 54 show extensive *fracture of both bones produced by*



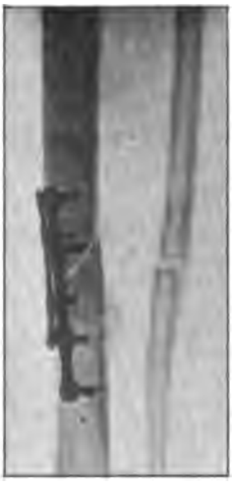


FIG. 55. FIG. 56.

direct injury. The damage to the soft parts was very great, the displacement of fragments and consequent deformity was very considerable on these grounds, and as the axes of the fibular fragments were not materially altered the fibular fracture was not exposed.

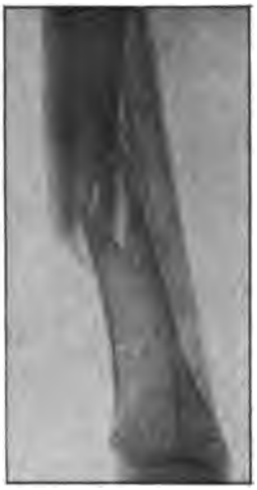


FIG. 57.

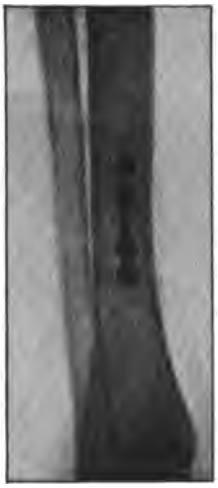


FIG. 58.

The tibial junction was effected most satisfactorily in the very difficult circumstances.

Figs. 55 and 56 show fracture of both bones produced by direct injury. The loose fragment of the tibia was placed in position, and was secured immovably to the adjacent fragments by two plates and screws. The restoration of the tibia to its normal form was accompanied by that of the fibula also.

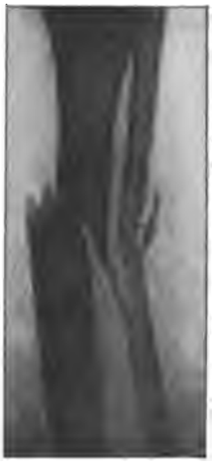


FIG. 59.

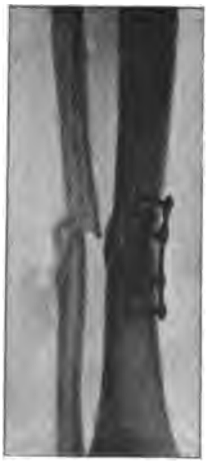


FIG. 60.

Figs. 57 and 58 show a fracture of the tibia and fibula at different levels. The fracture of the fibula is above the limit of the photograph. The fragments of the tibia were placed in accurate apposition and were secured by a single plate, the fibular fragments coming into perfect apposition in the process.

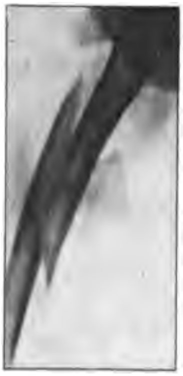


FIG. 61.

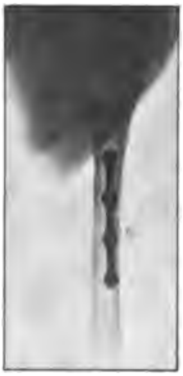


FIG. 62.

Figs. 59 and 60 show a fracture of the tibia and fibula by direct violence, both fragments being much comminuted. Considerable damage to the soft parts and the comminution of the tibial fragments rendered accurate apposition of the tibial fragments difficult and not absolutely perfect. The fibular reposition was also slightly imperfect.

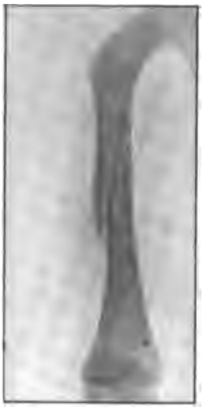


FIG. 63.

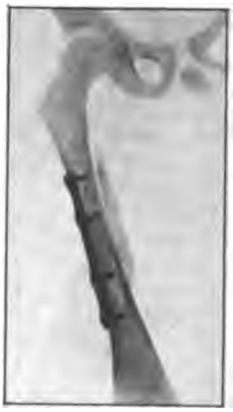


FIG. 64.

Figs. 61 and 62 show varieties of *torsion or spiral fractures of the femur*, both before and after operation.

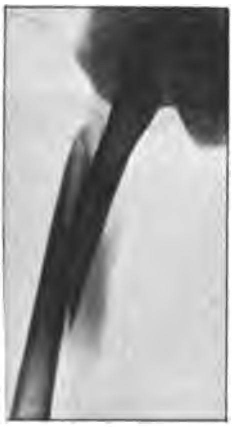


FIG. 65.

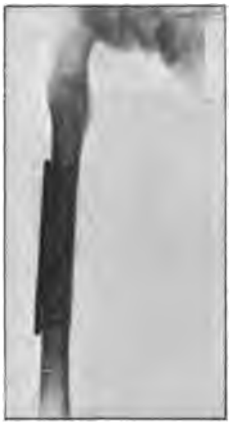


FIG. 66.

Figs. 63 and 64 shows a long piece of bone which has been left lying inside the shaft, whose outline has been restored to the normal. The subject being young, the fragment no longer serving to transmit any force, will be rapidly absorbed.

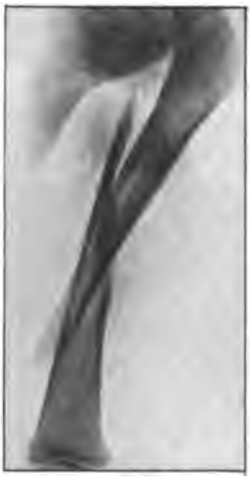


FIG. 67.

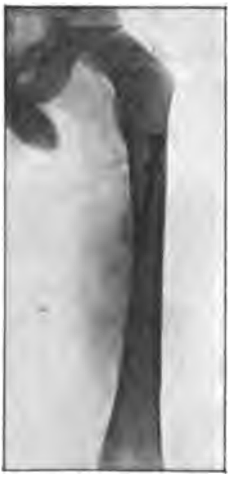


FIG. 68.

Figs. 65—68 show various types of spiral fracture both before and after operation. The results are perfect.

Figs. 69 and 71 show a spiral fracture of the femur with comminution.

Figs. 70 and 72 show the shaft returned to its normal form with the fragment on its inner side. The subject being a young one, the normal outline will be rapidly restored, and any projecting portion of fragment will be removed.

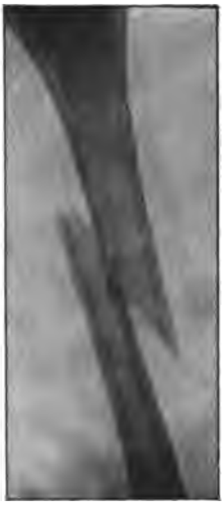


FIG. 69.

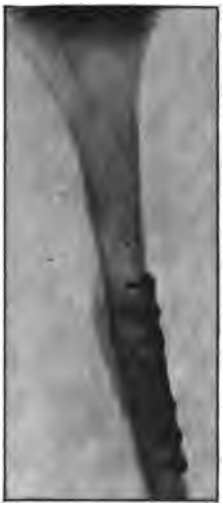


FIG. 70.

Figs. 73—78 show three short spiral fractures before and after operation. The shorter the spiral of the femur the more difficult is it to obtain accurate apposition, and the more tedious is the operative procedure.

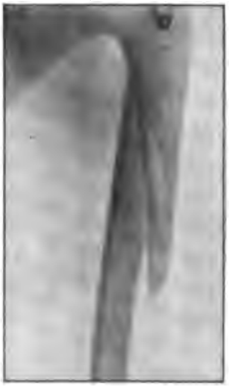


FIG. 71.

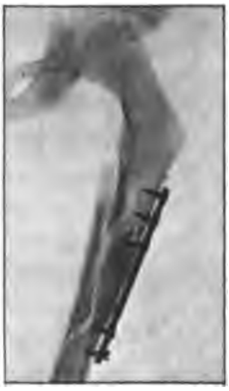


FIG. 72.

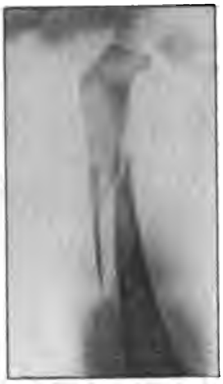


FIG. 73.

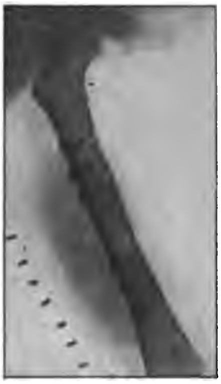


FIG. 74.

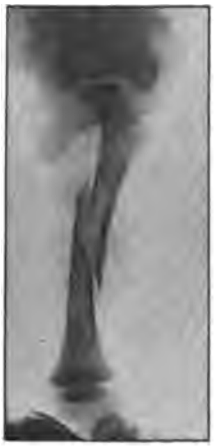


FIG. 75.

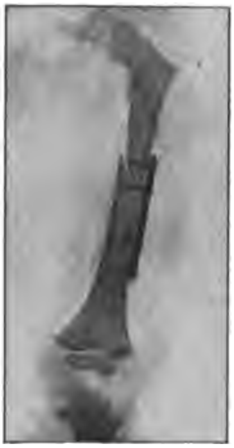


FIG. 76.

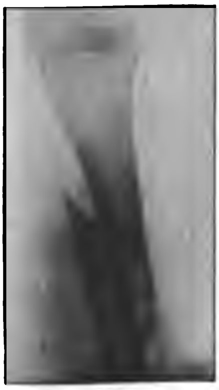


FIG. 77.

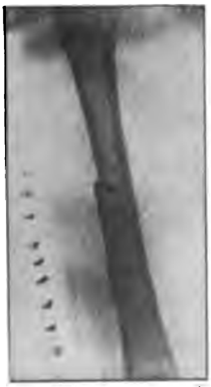


FIG. 78.

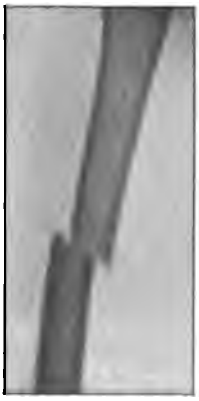


FIG. 79.

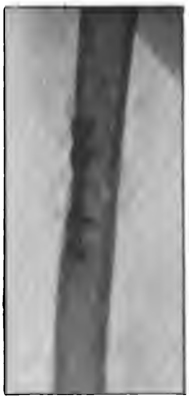


FIG. 80.

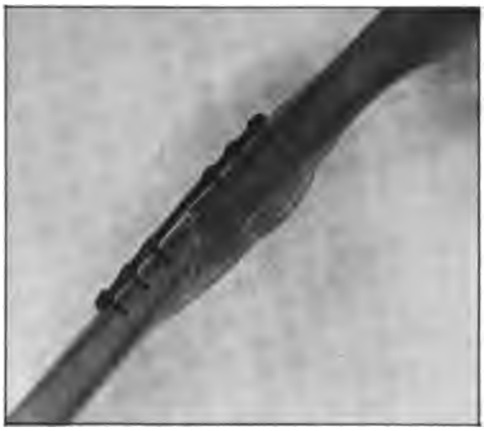


FIG. 81.

Figs. 79 and 80 show a fracture of the femur produced by direct injury both before and after operation.

Fig. 81 shows a fracture of the femur with some comminution

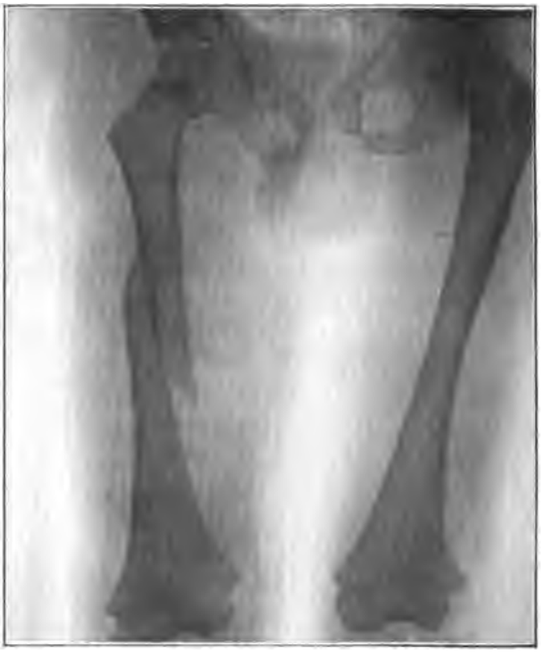


FIG. 82.

produced by direct injury after the bone has been restored to its normal form by operation.

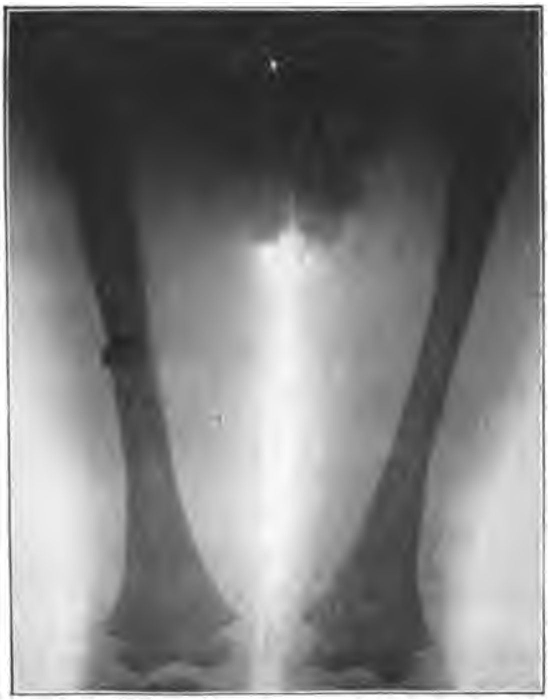


FIG. 83.

Figs. 82 and 83 show a fracture of the femur both before and after operation. The first radiogram shows the condition of supposed replacement in which the patient was left by the surgeon, the limb being encased in plaster of Paris bandages. These were removed and the fragments were restored to their normal relationship and the

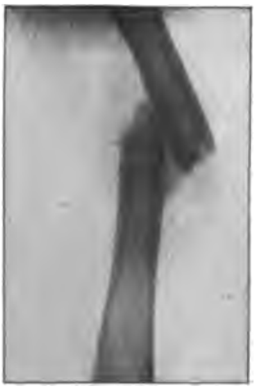


FIG. 84.

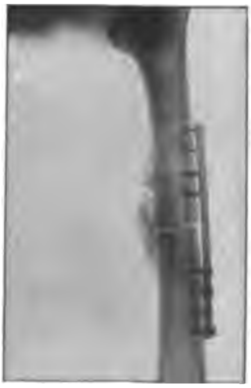


FIG. 85.

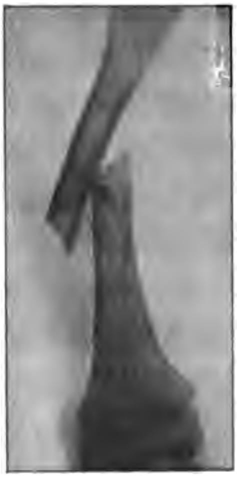


FIG. 86.

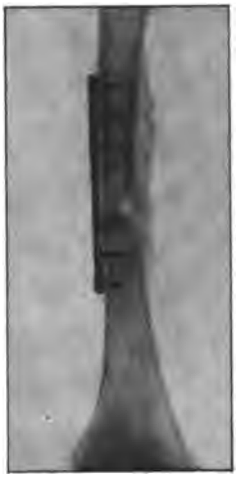


FIG. 87.

bone to its original form and function. The fragments were secured by a plate and screws, supplemented by a separate single screw.

Figs. 84—89 show *fractures of the femur which have been produced by direct violence*, in all of which a considerable interval has elapsed between the receipt of the injury and the operation, the patients having been previously treated by methods other than operation.

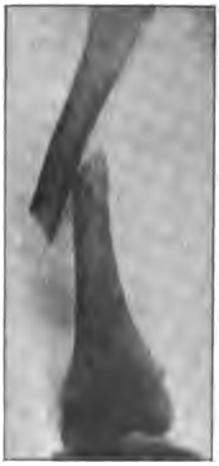


FIG. 88.

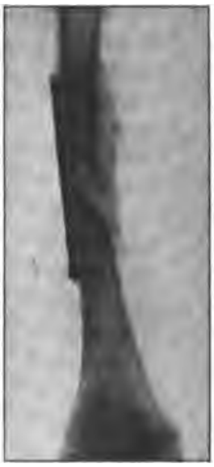


FIG. 89.

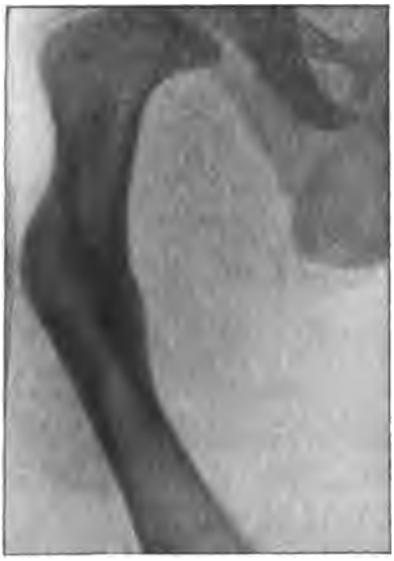


FIG. 90.

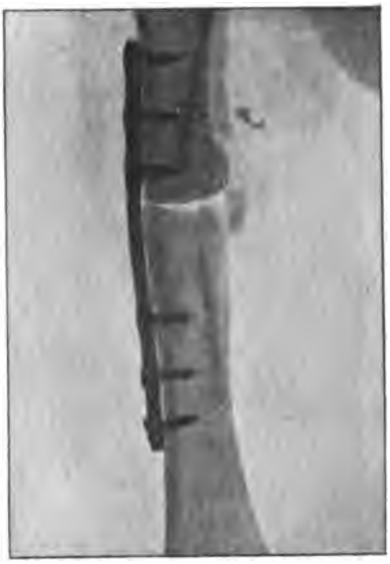


FIG. 91.

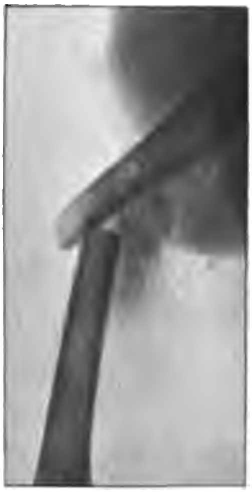


FIG. 92.

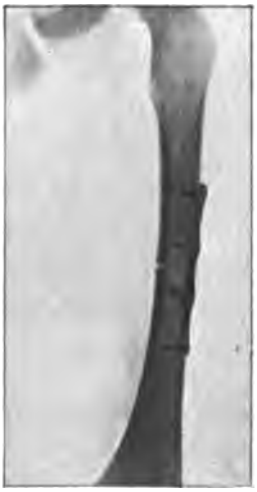


FIG. 93.

Fig. 90 shows a very deformed junction of a fractured femur in a child three years of age, eighteen months having elapsed since the receipt of the fracture. Fig. 91 shows the result of the operation. The femur is only ⅜ to ½ inch shorter than its fellow, while the continuity of the axes of the fragments has been restored. The leg was functionally perfect, since the small amount of shortening was readily compensated for.

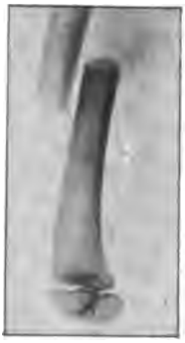


FIG. 94.

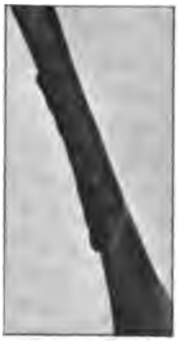


FIG. 95.

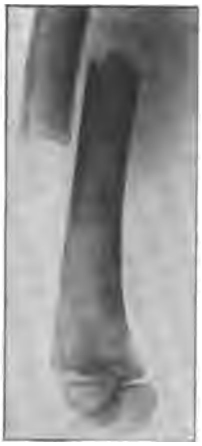


FIG. 96.

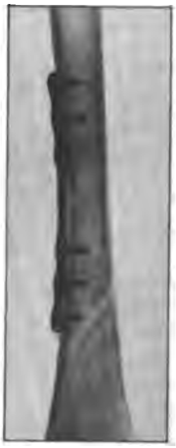


FIG. 97.

Figs. 92—97 show three recent fractures of the femur produced by direct injury and treated by operation with perfect results.

Figs. 98 and 99 show a fracture of the upper end of the femur in a child produced by direct injury. These cases require great

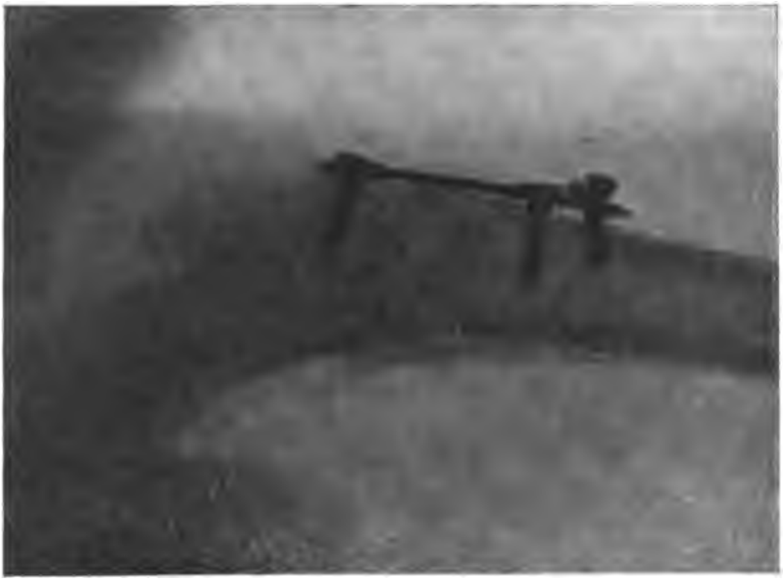


FIG. 99.

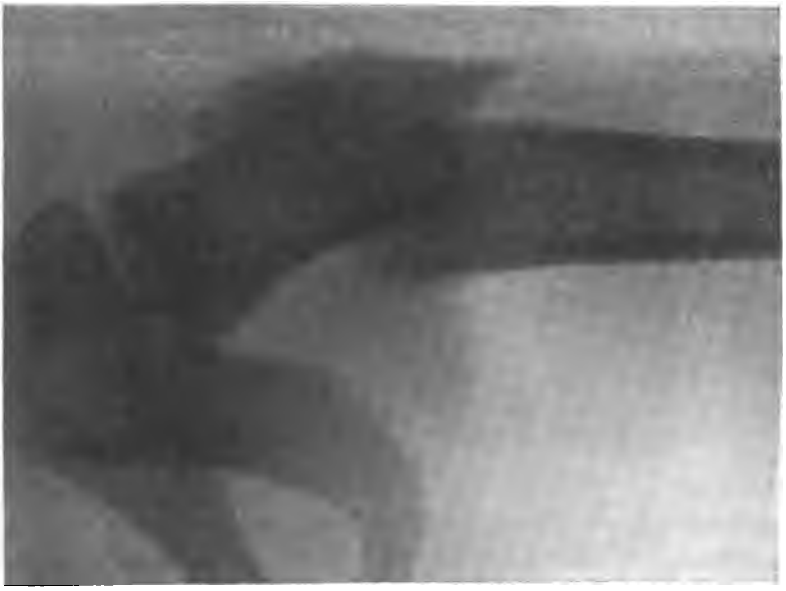


FIG. 98.

patience and manipulative skill in attaining accurate co-aptation of the fractured surfaces, since the texture of the upper fragment is of such a consistence that it can neither be held in a forceps nor can it be pressed upon effectually by any instrument without its being perforated and damaged by it.

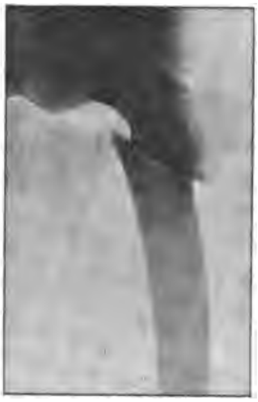


Fig. 100.

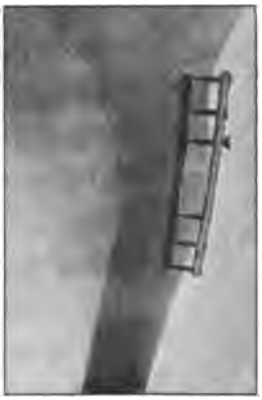


Fig. 101.

Figs. 100 and 101 represent a similar fracture in an adult. In this, however, the same difficulty does not exist, except that the presence of some comminution and crushing of the upper fragment made it necessary to use two plates with screws. In spite of this the alignment of fragments was not perfect. The plates have been touched up by the photographer to render their outlines more distinct.

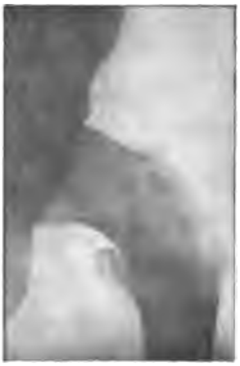


Fig. 102.

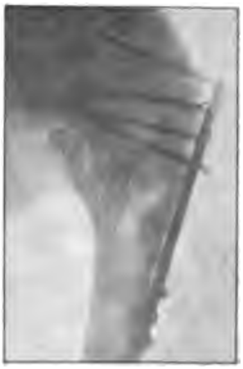


Fig. 103.

Figs. 102 and 103 show a bad, so-called extra-capsular fracture produced by direct violence. The fragments were dissociated and the bone restored to its normal form and function by the method illustrated by the radiogram.

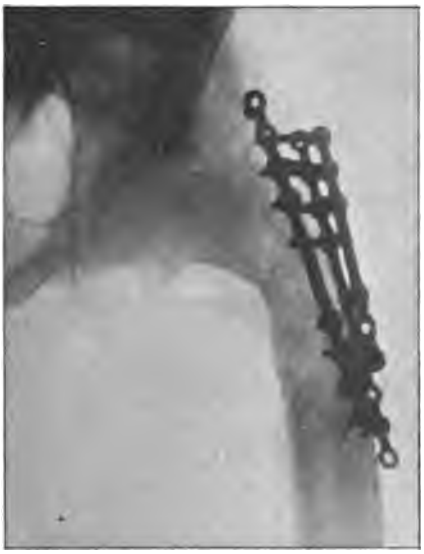


FIG. 104.

Fig. 104 represents the result of an operation upon a miner, well past middle life, who eighteen months previously sustained a severe comminuted fracture of the femur, leaving him with a

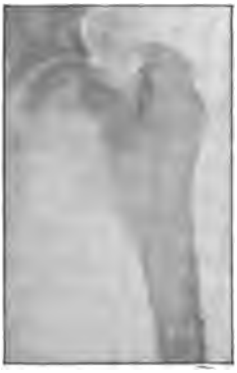


FIG. 105.

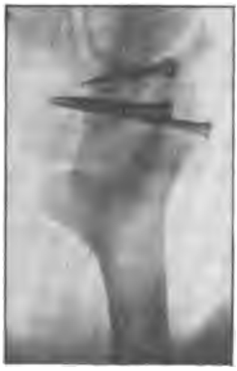


FIG. 106.

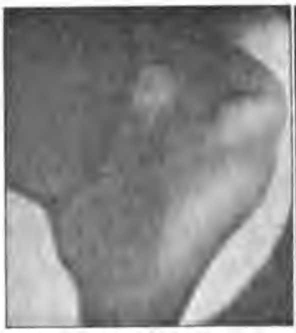


Fig. 107.

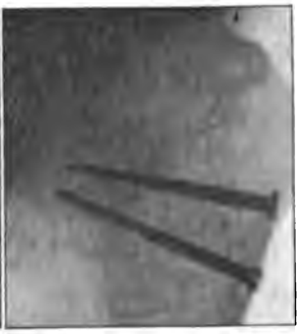


Fig. 108.

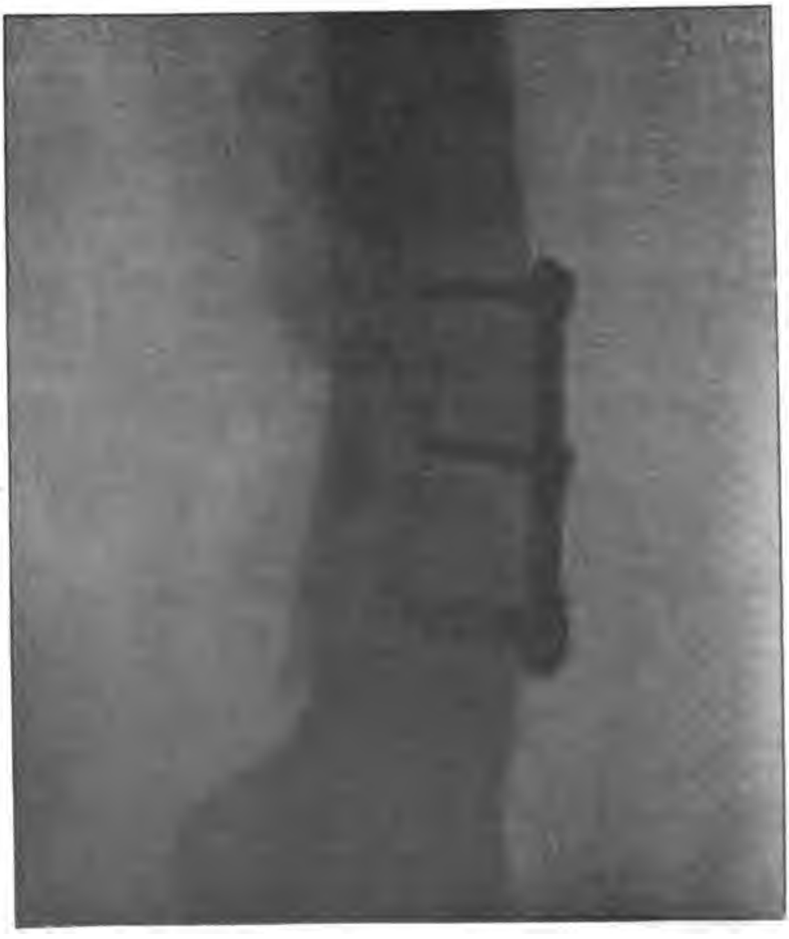


Fig. 109.

condition of great deformity and complete incapacity. The bone had become so thin and friable that after the deformity had been overcome as far as possible, the fragments had to be retained in position by three stout plates, screws being put in wherever they could find any sort of a grip. The result was as satisfactory as could be expected, the man being able to get about again and to return to his duties at the diamond mines.

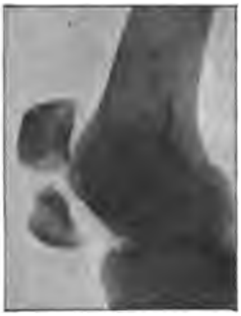


FIG. 110.

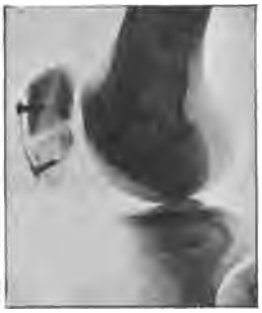


FIG. 111.

Figs. 105—108 show an ununited fracture of the neck of the femur with complete incapacity to bear weight on the new joint. The surfaces of the new joint were excised and the head was forced on to a much higher level, where it was secured by means of three long screws. The result functionally and anatomically was very satisfactory, the man being able to return to his occupation.

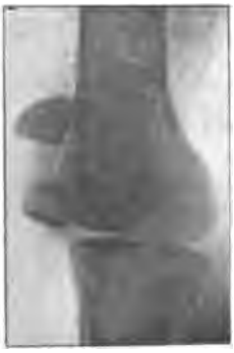


FIG. 112.

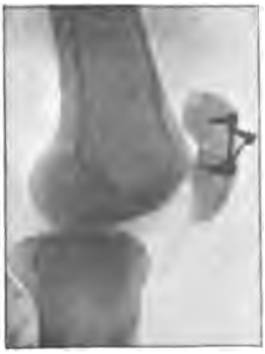


FIG. 113.

Fig. 109 shows the result of an operation on a fractured femur, in which the fragments had united in such a bad position that the limb was functionally useless.

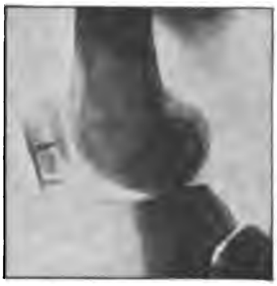


FIG. 114.

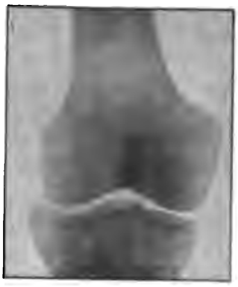


FIG. 115.

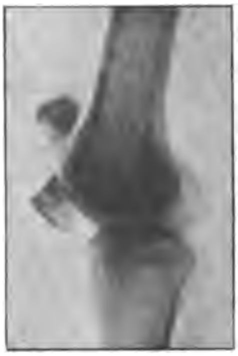


FIG. 116.

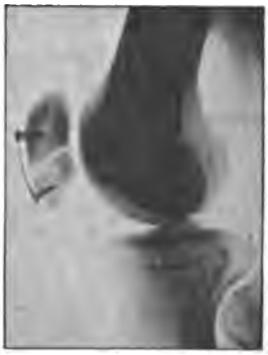


FIG. 117.

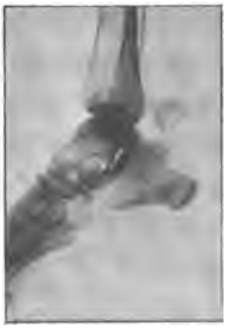


FIG. 118.

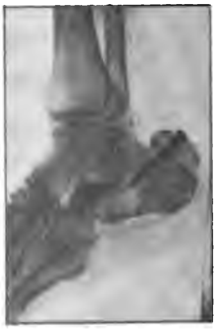
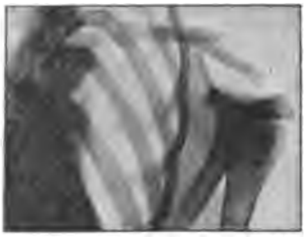


FIG. 119.

Figs. 110 and 111 show a *fracture of the patella* before and after operation.

In applying a plate in this situation it is important that it should lie directly on the bone, all intervening soft parts being removed, in order that the skin covering it shall not be irritated by pressure. While the soft parts are being removed and the plate fitted and fixed the fragments are held securely in a forceps specially constructed for the purpose, with long sharp teeth which penetrate the soft parts and impact on the fragments at a suitable angle (*see* Fig. 18).

FIG. 120.



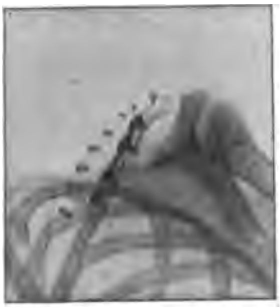


FIG. 121.

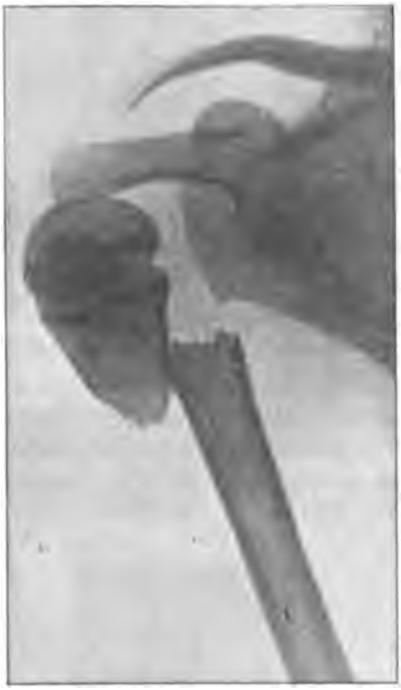


FIG. 122.

Figs. 112 and 113 show a comminuted fracture of the patella before and after operation. The fragments were united by a three-limbed plate secured by thin screws.

Figs. 114 and 115 show a fractured patella whose fragments have been united by a plate.

Figs. 116 and 117 show a condition and result precisely similar to the last.

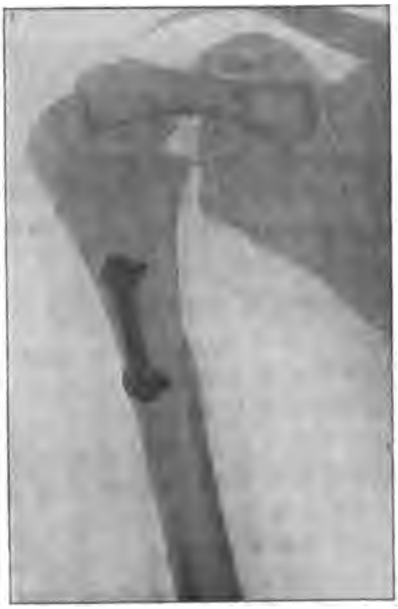


FIG. 123.

Fig. 118 shows a fracture of a portion of the *os calcis* with considerable separation of the fragment.

Fig. 119 shows the condition after operation, the fragment having been secured in position by means of a single screw.

Fig. 120 shows a fracture of the *clavicle* with much displacement of fragments, and Fig. 121 the clavicle restored to its normal form, the fragments being held securely in apposition by a plate and four screws.

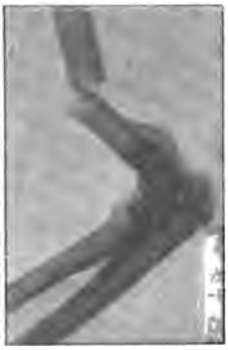


FIG. 124.

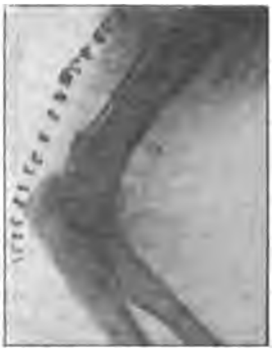


FIG. 125.

Fig. 122 shows a fracture of the upper portion of the shaft of the *humerus* with displacement of the fragments on one another.

Fig. 123 shows the result of operation, the bone having been restored to its normal form and function. The fragments have been secured by means of a steel plate and two screws.

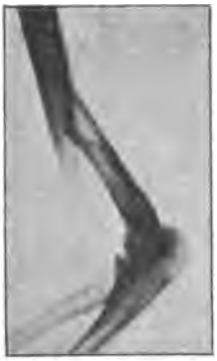


Fig. 126.

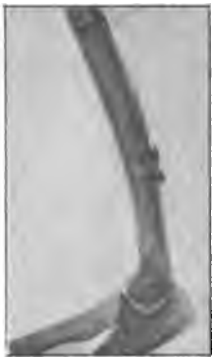


Fig. 127.

Figs. 124 and 125 show a transverse fracture of the humerus resulting from direct injury. The seat of fracture was exposed through a posterior incision and the fragments were brought into accurate apposition, being retained there by means of a vertically

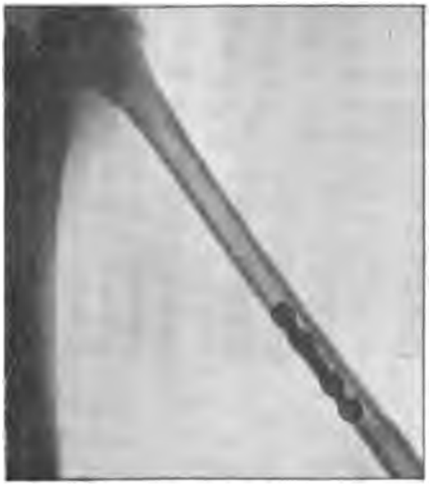


Fig. 128.

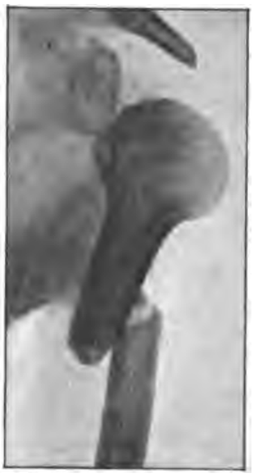


Fig. 129.

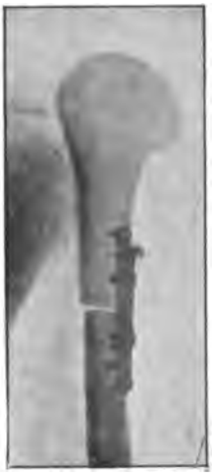


Fig. 130.

placed plate and screws. The Michel's clips had not yet been removed.

Figs. 126 and 127 show a spiral fracture of the humerus produced by torsion. Here, again, the fragments were exposed through a posterior incision, and having been put in position were secured by two small plates placed transversely.

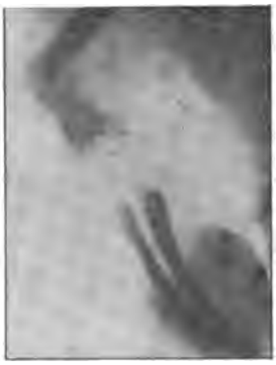


Fig. 131.

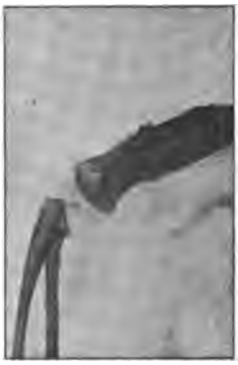
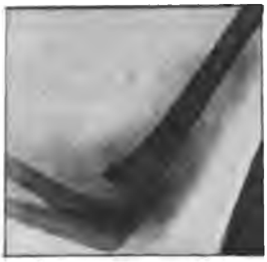


Fig. 132.

Fig. 128 shows the result of an operation on a transverse fracture of the humerus through its centre.

Fig. 129 represents an old imperfectly united fracture of the humerus of some considerable standing. The arm was useless for the purposes required of it.

FIG. 133.



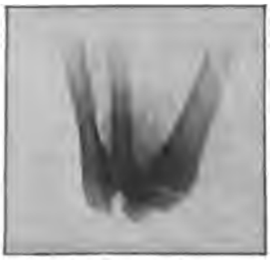


FIG. 134.

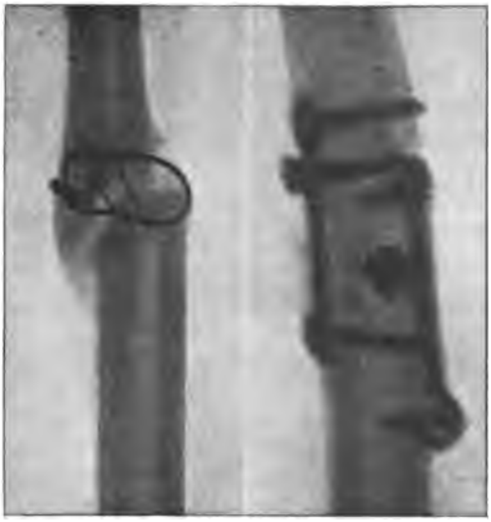


FIG. 135. FIG. 136.

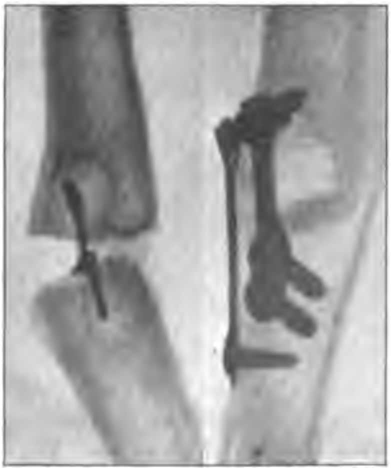


FIG. 137. FIG. 138.

Fig. 130 shows the result of operation, the humerus being restored to its normal form and function.

Figs. 131 and 132 show the humerus of an infant three weeks old which had been broken at birth. The fragments had united at a right angle. The musculo-spiral nerve was paralysed.

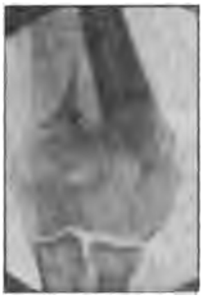


FIG. 139.

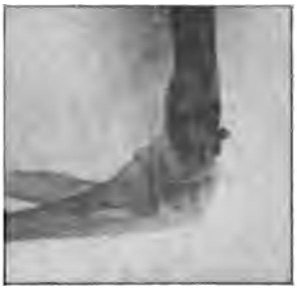


FIG. 140.

The seat of fracture was exposed and the musculo-spiral nerve was dissected out of the callus. The fragments were then separated from one another and were placed in continuity with one another.

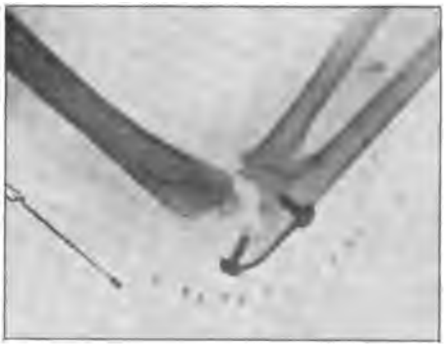


FIG. 141.

A plate was employed to retain the fragments with two screws. Owing to the rapid softening of the distal fragment, which takes place so rapidly at this early age, the distal screw had no sufficient hold. It was, therefore, necessary to secure the plate by a loop of wire encircling it and the lower fragment of the humerus. The paralysis disappeared and the arm became perfectly useful.

Fig. 133 shows the condition commonly described as separation of the lower epiphysis of the humerus. Fig. 134 shows the result of accurate replacement of the displaced lower fragment through a free posterior vertical incision.

Figs. 135 and 136 show an ununited fracture of the shaft of the humerus, which was accompanied by paralysis of the musculo-spiral nerve. The patient sustained originally a simple transverse fracture, with displacement of fragments. An ununited fracture resulted. Operation was followed by non-union and by paralysis of the musculo-spiral nerve.

The seat of fracture was exposed. The nerve was freed from the callus and wire. The wire was removed, and the fragments were prepared and were fixed accurately in apposition by means of two plates and screws and a separate screw. The paralysis recovered and the function of the arm was fully restored.

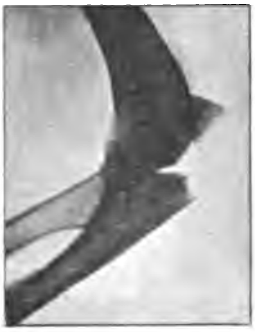


FIG. 142.

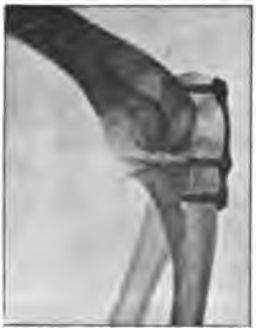


FIG. 143.

Figs. 137 and 138 show an ununited fracture of the humerus in which the fragments were connected by a loose loop of wire. Areas of rarefying ostitis are seen surrounding the loop of wire as it passed through each fragment. The wire was removed and the opposing surfaces of bone were flattened and were secured in apposition by two plates and screws. No attempt was made to excise the areas of rarefying ostitis. Union resulted with a perfectly useful arm.

Figs. 139 and 140 show a comminuted fracture of the lower end of the humerus resulting from a fall on the elbow. The fragments were brought into accurate apposition and were secured by means of a three-limbed plate and screws. Movement was perfect except for a trifling and inappreciable limitation of the range of extension of the elbow.

Fig. 141 shows the result on a fracture of the *olecranon* in a child. The fragment was replaced accurately in position and was secured by means of a steel plate, suitably curved, and by two screws.

Figs. 142 and 143 show a recent fracture of the olecranon in an adult and the result of operation.

Fig. 144 shows a fracture of the olecranon and a fracture of the coronoid process. Fig. 145 shows the result of operation. Not only is the olecranon fragment secured in position, but the coronoid fragment has dropped into its normal relationship with the base of that process. The result was functionally perfect.

FIG. 144.

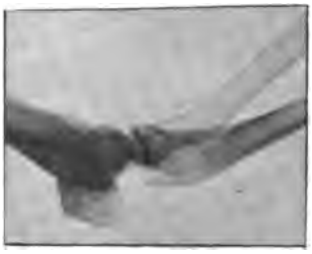
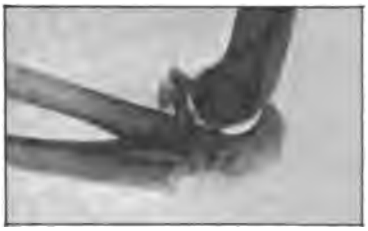


FIG. 146.



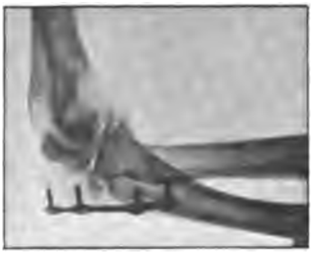


FIG. 145.

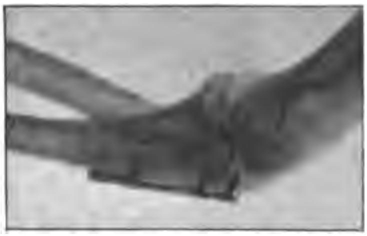


FIG. 147.

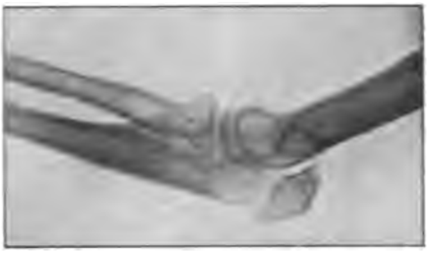
Figs. 146 and 147 show a fractured olecranon before and after operation.

Figs. 148 and 149 show a fracture of the olecranon before and after operation.

Fig. 150 shows a fracture of the *radius* with much displacement. Fig. 151 the result of operation.

Fig. 152 shows a fracture of the radius with much displace-

FIG. 148.



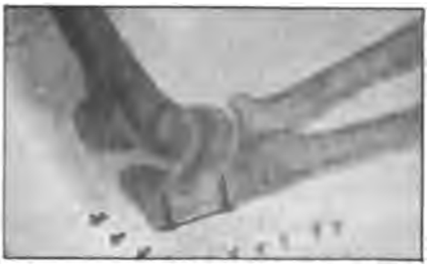


FIG. 149.

ment, accompanied by considerable comminution of the lower fragment. Fig. 153 shows the result of operation, the comminuted

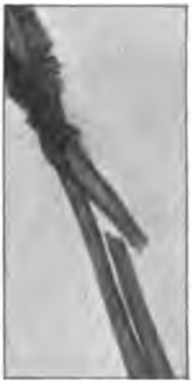


FIG. 150.

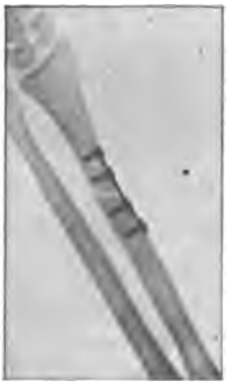


FIG. 151.

fragments being also secured in apposition by a second plate and screws.

Fig. 154 shows a fracture of *both bones of the forearm* at the junction of the lower quarter, with the upper three-quarters of their

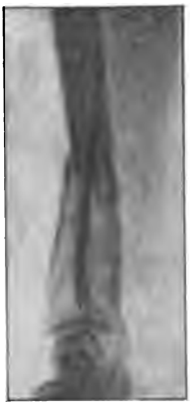


FIG. 152.

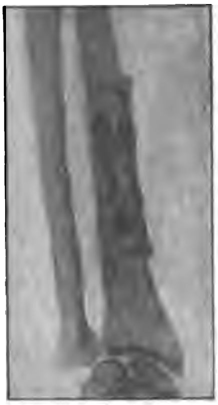


FIG. 153.

length. This photograph being in one plane only does not show the displacement of the radial fragments.

Fig. 155 shows the result of operation. The fragments of each

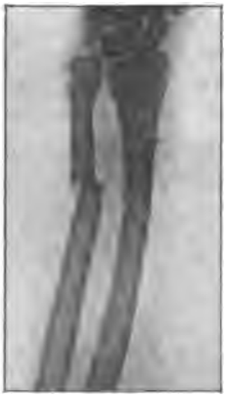


FIG. 154.

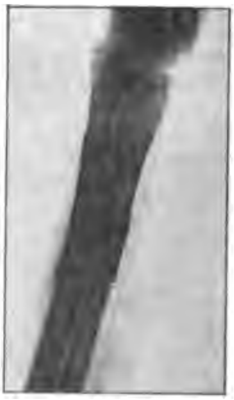


FIG. 155.

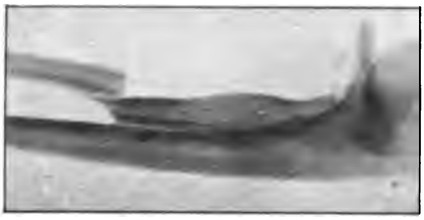
bone were placed in accurate apposition, and the ulna and radius were restored to their normal form and function.

Figs. 156 and 157 show a fracture of the radius in its upper third and with the result of operative interference.

Figs. 158 and 159 show a fracture of the radius and ulna at the same level and the perfect result of operative treatment.

Fig. 160 shows a somewhat similar fracture of the ulna and radius with displacement of fragments of several weeks' duration. Fig. 161

FIG. 156.



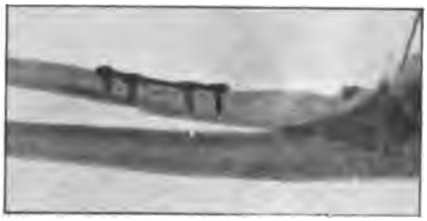


FIG. 157.

shows the result of replacement of fragments and their fixation by plates and screws.

Figs. 162 and 163 show a bad fracture of the radius and ulna in a young boy near their lower extremities. The ulnar fragments were replaced in position and were secured by a plate and screws, while the radial fragments, coming into good apposition, did not require any plate for their retention in place.

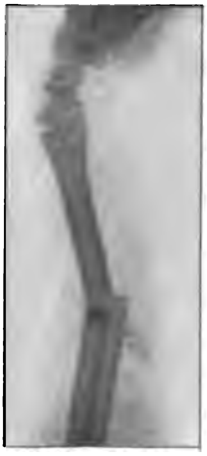


FIG. 158.

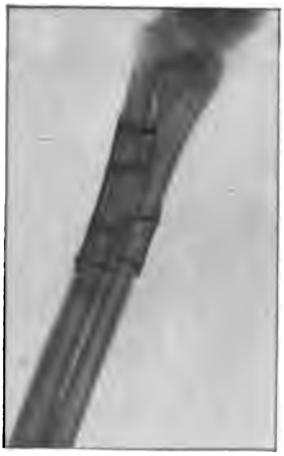


FIG. 159.

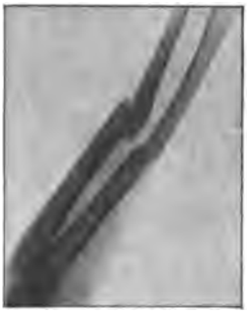


FIG. 160.

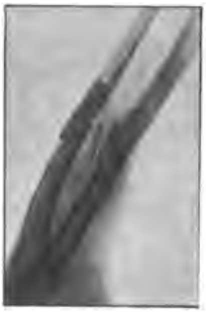


FIG. 161.

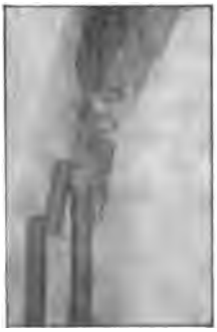


FIG. 162.

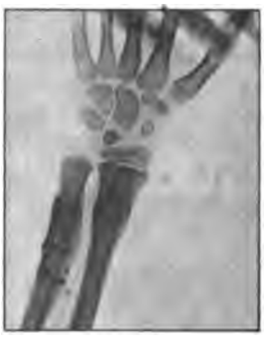


FIG. 163.

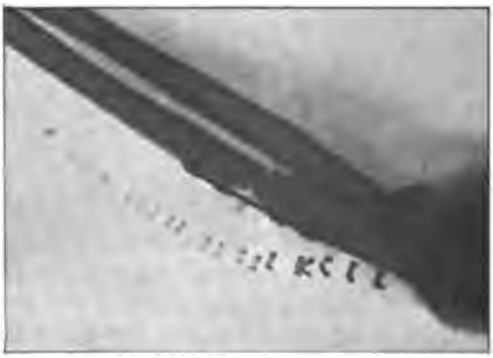


FIG. 164.

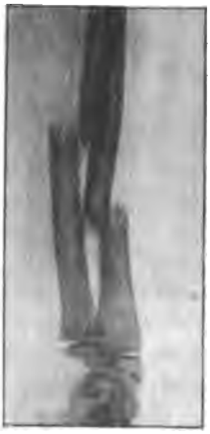


FIG. 165.

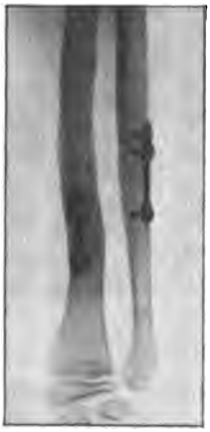


FIG. 166.

Fig. 164 shows a fracture of the ulna accompanied by much displacement of fragments of several weeks' standing. Apposition of the fragments in continuity was effected perfectly. The softening and alteration of the shape of the ends of the bone are shown up clearly in the photograph.

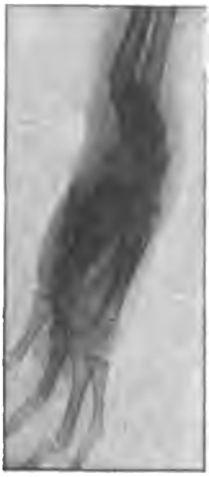


FIG. 167.

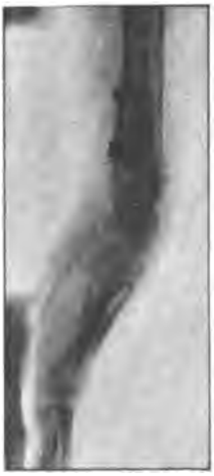


FIG. 168.

Fig. 165 shows fractures of the radius and ulna with much displacement of fragments. Fig. 166 shows the result of operation.

Fig. 167 shows a fracture of the lower end of the radius with

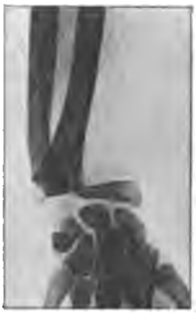


FIG. 169.

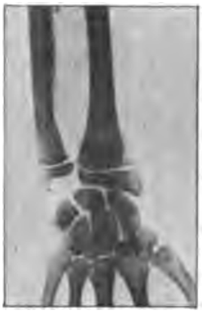


FIG. 170.

considerable backward displacement of the lower fragment. Fig. 168 shows the fragments in accurate apposition and securely fixed by a plate and screws.

Figs. 169 and 170 show a separation of the lower epiphysis of the

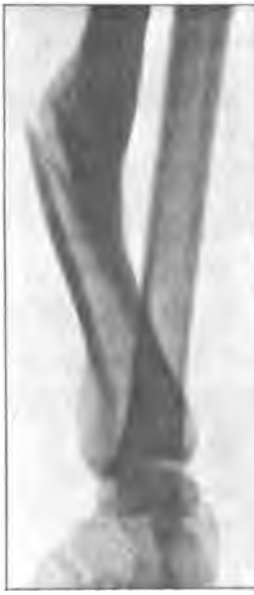


FIG. 171.

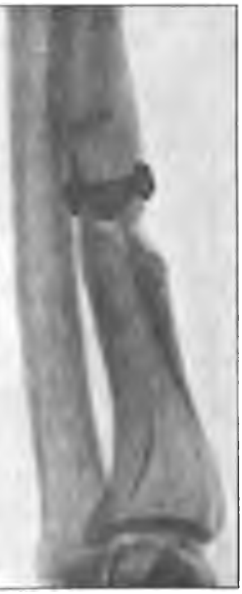


FIG. 172.

radius, forming the variety of fracture which at this age results from forcible abduction and extension of the wrist, being a variety of so-called Colles's fracture. A small portion of the shape is connected with the epiphysis. Every attempt at reduction by manipulation under an anæsthetic having proved useless, the fracture was exposed through a posterior incision and accurate apposition of fragments was effected by means of a fine elevator. The result was perfect functionally and anatomically.

Fig. 171 illustrates the result of treatment of a fracture of the radius by manipulation and splints, and Fig. 172 shows the method and result of operative interference.

W. ARBUTHNOT LANE.

REFERENCE.

Chapple, Harold. "The Treatment of Cases of Fracture of the Femur after Operation." Practitioner, 1910, LXXXIV., p. 257.

DISEASES OF BONE.

ACUTE INFLAMMATION.

Acute Non-suppurative Periostitis.—This is nearly always due to direct injury, is localised, and is, as might be expected, rarely seen except in bones which occupy an exposed situation. The tibia is affected more commonly than any other bone. The patient complains of a painful swelling of varying extent which makes its appearance shortly after the injury. He should be kept in bed, with an evaporating lotion applied to the part. The following prescription provides an excellent lotion for the purpose: Ammonii Chloridi, ʒj; Acidi Acetici Dil., ʒij; Spiritus Rectificati, ʒij; Aquam Destillatam, ad ʒxx.

The injured area should be carefully watched, and expectant treatment should not be employed for more than two days. If at the end of this time the swelling and pain have increased, an aseptic incision should be made down to the bone and the serous effusion evacuated. The danger of waiting indefinitely is that the underlying bone, which is deprived of its periosteal blood supply, may undergo necrosis and a laminar sequestrum be formed; and this may occur without the sub-periosteal effusion becoming infected. The wound should be sewn up and dressed with sterilised gauze. It usually heals rapidly.

Acute Suppurative Periostitis is, like the last condition, usually the outcome of injury, but may be the result of an infection starting in the centre of the bone.

When the process is localised there is a painful swelling in the course of a long bone, but it differs from the non-suppurative form in being exquisitely tender, hot and red. The redness extends for some distance into the adjacent tissues. The centre is soft and sometimes of a yellow colour. These signs are proof positive of the presence of a sub-periosteal abscess, and no time should be lost in making an incision down to the bone, for fear the infection should spread widely and involve the whole bone. The abscess must be evacuated and the wound dressed with fomentations. A weak antiseptic solution, *e.g.*, mercuric potassium iodide, 1 in 10,000, is to be preferred to the boracic solution which is usually employed, and gauze will be found better than lint for the purpose. If the process is localised and an incision is made early, necrosis of the underlying bone does not often ensue and a good result is usually obtained.

The only difference in treatment when the condition is diffuse and affects the periosteum covering the entire shaft is that the incision must be correspondingly longer. It must extend in each direction to just beyond the limits of the swelling, so that free drainage can be obtained and the whole of the affected portion of the shaft adequately examined at the time of operation. The problem which now confronts the surgeon is whether to open the medullary cavity of the bone with a trephine in order to discover whether it has been invaded by the septic process or not. The risk of doing so is that the medulla, if it has hitherto escaped, may subsequently become infected; while the danger of leaving it is that the patient may be sent back to bed with a medullary cavity full of pus under retention, and that he may rapidly become gravely ill from septic absorption. The former danger is the lesser of the two; and it may therefore be laid down as a rule that the interior of the shaft of the bone should be explored in every case in which the entire diaphysis has been denuded of its periosteum by a suppurative inflammation.

Often a sinus can be found leading down to the medulla, or more rarely the entire diaphysis is lying loose, having been separated from both epiphyses. In either case it is obvious that the condition is now one of osteomyelitis rather than of periostitis only.

In making the incision regard must be had to anatomical considerations; thus, in the case of the tibia and ulna, the incision should be made over the subcutaneous surface. If the femur is affected an external incision is most suitable because it can be carried from the great trochanter to the external condyle without risk of damage to any important structure. The bone in which the greatest difficulty will be experienced is the humerus, on account of the intimate association with it of the musculo-spiral nerve, which must not be injured. The best access is afforded by an incision on the postero-external aspect, at the outer border of the triceps muscle. The radius is best exposed on its posterior aspect.

If the operation has been undertaken on a bone lying superficially, such as the tibia, the whole wound should be left open and merely dressed with sterilised gauze; but in the case of a bone lying more deeply, such as the femur or the humerus, it is advisable to pack the wound lightly with gauze in order to prevent the soft tissues from closing over superficially. Each day when it is dressed the wound should be irrigated with a solution of hydrogen peroxide (5 to 10 volumes), since this drug has a particularly beneficial effect in suppurative conditions of bone.

In these cases the constitutional symptoms are severe and the patient needs stimulation. Alcohol should be prescribed. Quinine should also be given, preferably in effervescing solution ; ℞ Potassii Bicarbonatis, gr. 20 ; Aquæ Destillatæ, ℥j ; ℞ Quininæ Sulphatis, gr. 2 ; Acidi Citrici, gr. 14 ; Aquæ Destillatæ, ℥j. Signa : to be mixed and taken in a state of effervescence. The bowels should of course be kept freely open.

If the case is one of periostitis purely the condition should gradually subside under the treatment which has been described. The cavity between the bone and periosteum will become filled with granulation tissue and the wound will heal gradually from the bottom. But there are two less satisfactory possibilities. One is that the constitutional symptoms may remain as severe as before, in which case it is to be presumed that the whole medullary cavity is infected and that the drainage is inadequate ; the other is that the wound may persistently refuse to heal up in one or more places under which dead bone may be felt with a probe ; here the presumption is that a portion of the shaft has undergone necrosis and is now lying loose as a sequestrum.

In either of these cases it may be taken for granted that the original periostitis has gone on to osteomyelitis, acute in the first case and sub-acute in the second. (For treatment *see* under next heading, Osteomyelitis.)

Acute Suppurative Osteomyelitis.—This is a condition in which all the elements of the bone are involved in an acute infective process. It may result, as has been said, from a primary suppurative periostitis, or the infection may start in the medulla and subsequently involve the more superficial parts. This form is more commonly seen in children debilitated by a recent attack of one of the common exanthemata. In either case the treatment is identical. As soon as the diagnosis is established no time should be lost in making a free incision over the affected bone ; the best situations for the incision in the case of the long bones have been indicated above. The incision must be long enough to expose the whole area of infected bone ; the periosteum must next be incised from end to end, and any sub-periosteal pus that may be present evacuated. The medullary cavity must be thoroughly exposed. Many surgeons advocate the preliminary use of a trephine, followed up by the chisel. Personally I think the use of a trephine should be avoided, because it necessarily takes some time, and every moment that can be saved in these cases is extremely valuable, since the patient is always gravely ill and it is therefore desirable to make the operation as short as possible. I therefore advocate two longitudinal incisions with a chisel, sloping towards one another internally, so that a long strip of bone, wedge-shaped in cross section, can rapidly be removed. In this way the whole medullary cavity can be thoroughly exposed. The underlying medulla will be found highly vascular and infiltrated with pus. The medullary canal must be cleared of its septic contents. This is best done by swabbing the cavity from end to end with a series of small swabs of sterilised gauze on holders. The practice of scraping with a sharp spoon cannot be too strongly condemned; it is obviously impossible to remove mechanically all the septic material, while living osteogenetic cells that have not yet been destroyed may be ruthlessly removed. It is equally useless to swab out the medulla with pure carbolic acid, as is often advised, the effect of such powerful antiseptics being rather to inhibit phagocytosis than to accelerate the processes of repair.

That such practices are founded on an unscientific principle will become obvious if it is borne in mind that the surgeon's whole aim and object in acute osteomyelitis is to allow free drainage for the discharge of septic material, so that the patient's diminished resistance to the infection may be increased and his natural processes of repair brought into play. For the same reason no attempt should be made at this stage of the disease to remove bone for any other purpose than to afford drainage, since it is impossible to tell how much bone is irretrievably dead and how much has a chance of recovery.

There is one exception, however, and that is the case in which the whole diaphysis has been separated at both ends and lies loose in the wound as soon as the periosteum is opened. It then has no chance of recovering and is better removed at once than left to form a sequestrum.

The medulla should be lightly packed with plain sterilised gauze; the object of this is to keep the soft tissues from falling together and uniting superficially. In two or three days, when this object has been attained, the gauze should be removed entirely.

Occasionally in acute osteomyelitis there is no alternative but amputation of the limb if the patient's life is to be saved. It is difficult to lay down hard and fast rules, since each case must be judged on its merits. But it may be said that amputation is indicated if symptoms of septicæmia or pyæmia are present, if the constitutional symptoms are excessively severe, as they occasionally are in debilitated young children or in feeble elderly people, and lastly, if an adjacent joint has been involved and an acute septic arthritis has been set up.

Special mention must be made of a particular form of acute osteomyelitis occurring in amputation stumps. Infection of the medulla occurs at the time of operation and rapidly spreads up the bone. The condition is becoming less common with the perfection of antiseptic technique. When it occurs there should be no hesitation in re-amputating the limb at a point above the limit reached by the infection. Acute osteomyelitis of the tarsal bones is occasionally seen as the result of a septic wound of the foot. Any wound in this neighbourhood should be carefully treated with antiseptic dressings, but on account of the cancellous nature of the bones and the complicated arrangement of the synovial membranes, the inflammation sometimes spreads rapidly and demands amputation on account of the widespread disorganisation which it causes.

Acute Epiphysitis.—The epiphysis of a long bone may be attacked by an acute septic infection or disease in it may be secondary to an osteomyelitis spreading from the diaphysis.

The primary form generally occurs in children, is of a particularly virulent nature, and demands immediate surgical treatment. The surface of the epiphysis should be exposed by a suitable incision and the bone opened either with a trephine or a gouge. This will be found comparatively easy, since the epiphysis, being composed of cancellous tissue, which is normally soft, is softer still when it is acutely inflamed. The softened and inflamed tissue of the centre of the epiphysis should be removed and the opening enlarged if necessary, so that good drainage is afforded. The surgeon should not be cramped in these cases by anatomical considerations. It is unlikely in any case that the epiphyseal line will survive. The bone should therefore be opened up to the limits of the infection, and if, as often is the case, the adjacent joint is already infected and in a state of septic arthritis, the synovial cavity must be freely opened and drained with one or more tubes. Too much stress cannot be laid on the fact that half measures in a case of acute epiphysitis jeopardise the life of the patient. The subsequent treatment is the same as that already described for osteomyelitis. If the patient recovers much deformity is likely to ensue; shortening of the limb in the case of a single bone, such as the humerus or femur, and malposition of the hand or foot in the case of the bones of the forearm or leg. (For treatment of this condition *see* under Deformities.)

Sub-acute Suppurative Osteomyelitis.—This may supervene in a case of acute osteomyelitis which has been treated in the manner described if any portion of the bone has necrosed, as it nearly always does. The wound tends to close up gradually except at one or two points which persist as sinuses. As a result of the irritation of the presence of a portion of dead bone the overlying periosteum becomes very much thickened, calcareous salts are deposited in it, and it forms a new bony covering outside the original shaft.

Such a condition may occur spontaneously in a septic osteomyelitis due to staphylococci of low virulence. The bone necroses slowly and the periosteum forms a firm involucrum, in which apertures called cloacæ make their appearance. Through them small portions of necrosed bone are continually discharged to the exterior. The constitutional symptoms are not severe.

In the treatment of such cases the surgeon has a freer hand, since the patient's life is not immediately endangered.

The first thing to be remembered is that a complete and permanent cure cannot be expected until all the sequestrum has been removed. As long as any necrosed bone is present, the sinuses will persist indefinitely. Two questions then arise, how to remove the sequestrum, and when. The second is the more difficult matter to decide. Radiography gives most valuable assistance here. The limb should be X-rayed from time to time and particular regard paid to the ends of the sequestrum. As soon as there is definite evidence of rarefaction an attempt may be made to remove the sequestrum or sequestra as the case may be.

The importance of operating at the right moment literally cannot be exaggerated. It must be remembered that a sequestrum can only be separated from the living bone by natural processes. Until these are complete no surgeon can define the line of demarcation. To interfere too early, therefore, is to subject the patient to an unnecessary operation; while, on the other hand, undue delay will give the periosteum time to become a definitely bony involucrum and thus after removal of the sequestrum a large cavity is left which it is very difficult to obliterate; and in the event of extreme procrastination the patient may even begin to exhibit signs of amyloid disease. On the whole, however, it is better to wait a little too long than to operate a little too early, and this is especially the case if it is the femur that is diseased. Here the presence of a bony involucrum is an advantage, since, if it is strong enough to resist the contraction of the muscles, after removal of the sequestrum, shortening of the limb which might otherwise occur will be avoided.

In operating a tourniquet should be applied to the limb if possible; otherwise the patient may lose an alarming quantity of blood, and the structures with which the surgeon is dealing are unnecessarily obscured. The line of the incision is the same as that which has already been described for the acuter lesions, but if any sinuses are present, the incision should if possible include them, and they should be excised by means of elliptical incisions which surround them. The bone itself is often much enlarged owing to the periosteal thickening, and the superficial structures are so adherent to it that it is necessary to free them with a rugine through the whole length of the incision.

The periosteum is next opened along the whole length of the incision; if it is merely thickened and inflamed it may be incised with a scalpel and reflected in both directions; but if calcareous salts have already been deposited in it and a definitely bony involucrum has been formed, two longitudinal incisions must be made with a chisel, and the intervening portion removed.

The cavity in which the dead bone is lying and the condition of the sequestrum can then be examined. If it is small and loose it is easily removed with sequestrum forceps. Some difficulty may be experienced when the sequestrum is a long one comprising the whole circumference of the bone. The best thing to do in such a case is to divide it transversely at its centre with bone forceps, and remove the two halves separately. The whole cavity must then be thoroughly cleaned out; here it is justifiable to scrape with a spoon to get rid of the septic granulation tissue which lines the cavity and to make sure that no smaller sequestra are lurking behind. If any are accidentally left they will retard the process of healing and probably necessitate a second operation.

But in spite of the greatest care it is often found that small secondary sequestra have escaped unnoticed. Their presence retards the closure of the wound. It is therefore well to X-ray the limb shortly after the first operation to see if this is the case.

The limb should be put upon a splint which fixes the joint at either end of the affected bone. This is particularly necessary in the case of single bones like the femur and humerus. If it is not done the periosteal involucrum may be fractured, and the chances of getting a good result are correspondingly diminished.

The after-treatment demands great patience, the object being to obliterate the cavity formed by the removal of the sequestrum. The wound must be dressed daily; at the end of the second or third day the gauze packing may be removed from the bone cavity, but it is still necessary to pack one or more pieces between the cut edges of the soft tissues, since they show a tendency to unite and close up, leaving only a small and insufficient aperture for the discharge of the septic contents of the bone cavity.

The ultimate aim of the surgeon is to produce a complete obliteration of the cavity. Theoretically this is impossible as long as its interior remains septic, as it always is in an osteomyelitic case.

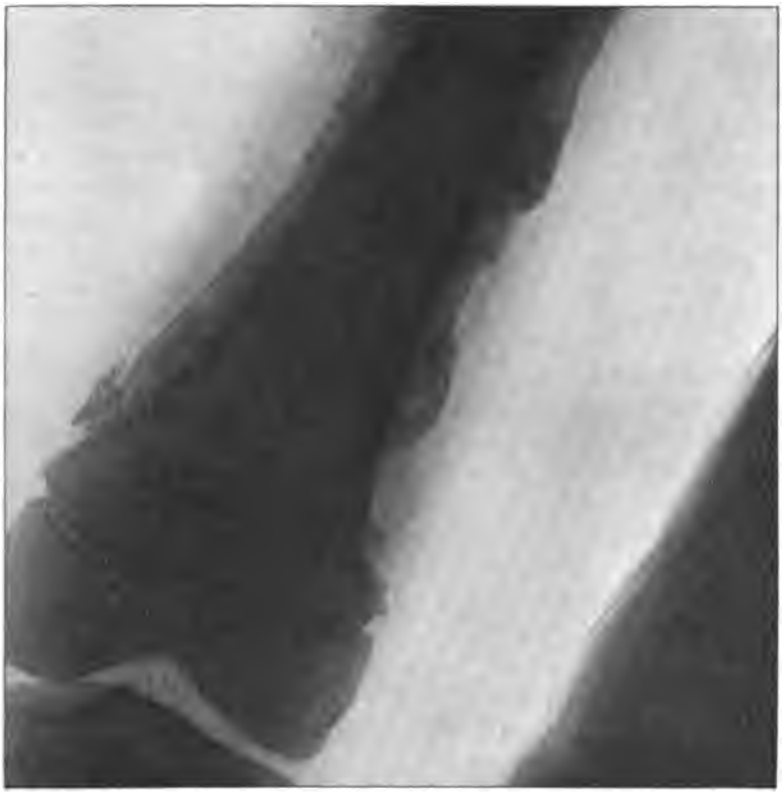


FIG. 1.—Osteomyelitis of Femur, showing dead shaft and new bony involucrum.

It is better to stay one's hand than to interfere in a hurry. Let us take, for example, a case in which a sequestrum comprising the whole shaft of the femur has been removed. If a series of radiograms is taken during convalescence it will be found that the cavity generally tends to become smaller by being gradually filled in with new bone from above downwards; but after a time, varying from three to six months, this natural process stops and a persistent cavity is left at the popliteal end, whose contents are discharged through a sinus.

It is only when the natural process of healing has been given a prolonged trial that further operative measures should be undertaken.

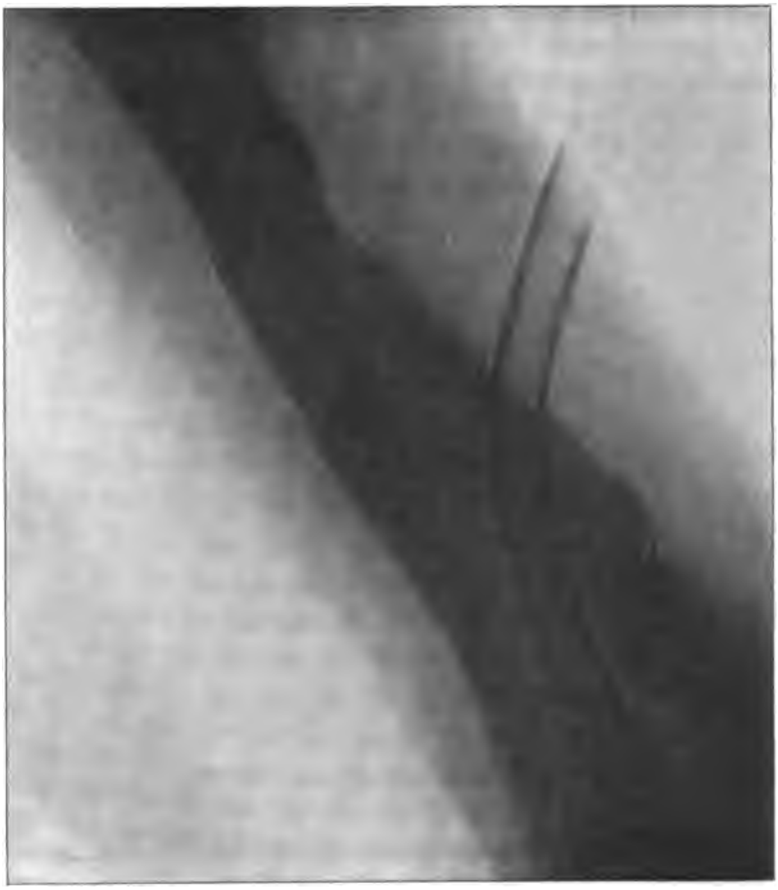


FIG. 2.—Osteomyelitis of Femur—same case as last figure—three months after subperiosteal resection of lower ⅔ of shaft. A tube can be seen draining popliteal end. The tube was taken out and healing was complete three months later.

The whole object of this second operation is to render the cavity aseptic. The opening should therefore be enlarged and the walls of the cavity which contain the septic material are removed with a chisel in all directions until sound bone is reached, and the cavity then swabbed out with a solution of liquefied carbolic acid to destroy any septic elements which have remained behind. The introduction of foreign bodies is not recommended. If the cavity has been rendered aseptic it will be filled with healthy blood clot, which is the best possible scaffolding for the ingrowth of granulation tissue, and the cavity will become obliterated of its own accord; whereas if any foreign substance is introduced and the cavity is not absolutely aseptic, it will have to be removed subsequently. Of all the foreign substances which have been advocated for introduction into bone cavities Moorhof's sterilised iodoform wax is the least objectionable. Not infrequently, however, the patient is left after a suppurative osteomyelitis with a cavity in the bone of varying size, which drains through a persistent sinus. In certain special cases a better result can be obtained by freeing the superficial structures and allowing them to adhere to the bottom of the cavity in the bone. This can rarely be done except in the case of the tibia where the cavity lies superficially.

CHRONIC INFLAMMATION.

Chronic Traumatic Periostitis.—Periosteal effusions due to injury sometimes require incision, as has been said. More often they appear to subside completely under expectant treatment, but occasionally definite periosteal thickenings are left which occasion the patient much inconvenience, since the area is excessively tender if it is accidentally struck. This condition is usually found in the region of prominent processes such as the condyles of the humerus. Local treatment consists of counter-irritation; the application of a blister or the naked cautery over the spot is often sufficient to effect a cure. Aspirin (10 gr.) three times a day is also useful, as is potassium iodide, by virtue of its action as a connective tissue solvent. In more resistant cases it may be necessary to make an incision down to the thickened periosteum and incise it, a procedure which rarely fails to cure the condition.

Syphilitic Disease of Bone.—Syphilis attacks bones in two ways; it either sets up a general sclerosing osteitis or forms a localised area of necrosis which may be superficial or deep.

In the treatment of the first form the ordinary anti-syphilitic remedies should be tried, but it is better to give potassium iodide in conjunction with mercury than alone. If the condition resists medicinal treatment the cure may be accelerated by operation, but in this case it is not sufficient merely to incise the periosteum. A portion of bone should be removed with a chisel, so that a groove is left, extending from one end of the thickening to the other, and triangular in cross section.

If a gumma is situated on the surface of the bone, it soon becomes attached to the overlying tissues and may form a fluctuating swelling. An incision should be made down to the bone and all the necrotic tissue evacuated. The wound should be sewn up. Medicinal treatment should be given as in the former case. The result is nearly always good.

When the gumma is central the treatment is essentially the same, but there is a difference in the technique, because there is generally an enlargement of the bone surrounding the focus, and this must be chiselled through before the necrotic tissue can be reached. Occasionally a small sequestrum is found in the centre of the cavity surrounded by necrosed bone. Sir James Paget labelled this condition "quiet necrosis"; it is probable that many of the cases which he so called, if not all, were either syphilitic or tuberculous in origin.

The cavity when clean may be filled with decalcified bone chips or Moorhof's iodoform wax, but results as good, if not better, are obtained by allowing it to fill with blood clot. The wound should be carefully sewn up.

Tuberculous Disease of Bone.—1. *Tuberculous Epiphysitis* commonly attacks the cancellous bone of the epiphysis, and since this has little resistance it tends to spread either towards the surface, between the epiphyseal line and the articular cartilage, or towards the joint cavity. In the case of the upper ends of the femur and of the ulna, where the epiphysis lies entirely inside the joint-capsule, it always follows the latter course and tuberculous disease of the joint ensues. In other cases the infection may remain limited to the bone for a considerable period.

It is extremely difficult to establish the diagnosis. Apart from localised tenderness and occasionally the presence of a swelling, there is little to go on in the early stages. Some assistance is afforded by the tuberculo-opsonic index, but from a surgical point of view more help is obtained by skiagraphy. A tuberculous focus is indicated by a light area. If this is quite small and central it is justifiable to try the effect of palliative measures, rest and the application of a counter-irritant (Scott's dressing is the most useful), together with general treatment, *e.g.*, country air, nourishing food, and the administration of cod-liver oil. At the same time a series of skiagrams should be taken at regular intervals. If, in spite of treatment, the focus is getting larger, operative treatment should be undertaken with the object of eradicating the focus entirely.

Too much stress cannot be laid on the fact that the whole operation must be strictly aseptic. If staphylococci are introduced, it is more than likely that a permanent discharging sinus will result, and that harm will be done to the patient rather than good. It was the lack of this precaution which accounted for the reluctance of surgeons to interfere in these cases in the pre-antiseptic days.

A suitable incision should be made to expose the affected epiphysis as near as possible to any localised swelling or tender spot. The periosteum is then divided. If the tuberculous focus consists of a caseating area the bone is softened, and the whole diseased portion can be removed with a sharp spoon until the walls of the cavity are exposed. If, however, a sequestrum is present, it is likely that there will be some dense bone over it which must be first removed with a chisel and mallet. A tuberculous sequestrum differs from that which is found in septic conditions; it is denser in consistency and separates more slowly, so that it often has to be wrenched from its surroundings with sequestrum forceps instead of coming away quite easily. After the sequestrum has been removed the walls of the cavity in which it lay must be fully exposed.

The next step is the same in either case, whether one is dealing with a caseous focus or a sequestrum. A thin layer of bone must be removed from the cavity all round to the depth of about ¼ inch. Unless this is done, tuberculous disease will be left behind and the operation is foredoomed to failure. The treatment of the cavity is the next question. When all the disease has been removed it may be swabbed out with pure carbolic acid and allowed to fill with blood clot and the overlying structures sewn up in layers with interrupted catgut stitches; the result of this method is generally satisfactory. But Mr. H. J. Stiles, of Edinburgh, advocates the introduction into the cavity of a preparation which he calls " sublimated iodoform bismuth paste." It consists of a mixture of 1 part of iodoform and 2 parts of subnitrate of bismuth stored in 1 in 1,000 solution of perchloride of mercury. He says of it: "This mixture is preferable to dry iodoform, to the glycerine emulsion or to the ethereal solution. Its advantages are that it is less toxic, so that more of it can be used, and that it forms rather more of a paste than sublimated iodoform alone."

The old-fashioned method of stuffing a bone cavity with gauze has nothing to commend it. To do so is a tacit confession that the operator has been unable to remove all the diseased bone; and it has the grave disadvantage that it is more difficult to keep the wound aseptic during the daily dressings that are necessitated.

2. *Tuberculous Osteomyelitis.*—Tuberculous disease also attacks the diaphyses of long bones, particularly in children and adolescents. The infection generally starts on the diaphyseal side of the epiphyseal line. From here it may travel into the epiphysis, but as often as not it infects the shaft. Sometimes it would appear that the infection starts in the medulla itself. The same difficulty presents itself in the diagnosis of the early stages as in the case of tuberculous epiphysitis already mentioned; but here again X-rays are invaluable.

Until recent times the treatment of this condition was mainly palliative and no operation was undertaken until the disease had made its way to a point near the surface, so that a fluctuating swelling was formed. This meant that there was now a definite abscess which had made its way through the periosteum, and had necessarily involved the superficial structures *en route.* More recently our ideas have undergone a change in favour of the sub-periosteal resection of the whole diseased area. Mr. H. J. Stiles is one of the pioneers of this early radical treatment, and the reader is referred for further details to his admirable article in Mr. Burghard's " System of Operative Surgery," Vol. II.

He exposes the affected bone, incises the periosteum, and saws through the shaft by means of a Gigli saw passed round the bone, between it and the periosteum. If the disease is confined to a central portion of the shaft, the bone is sawn through in two places, beyond the limits of the disease, as determined by X-rays, and the intervening portion removed. If, however, one end is diseased down to the epiphyseal line, the bone is sawn through as before, but the end of the diseased portion is raised from its periosteal bed and wrenched away from the epiphysis. In his experience, the epiphysis is not damaged by this manœuvre but is left intact, so that there is no subsequent shortening of the bone. In either case the incision in the periosteum is sewn up with interrupted catgut sutures and the wound is similarly closed in layers. New healthy bone is laid down inside the periosteum, which unites with the portions which have been left; and judging by the skiagrams which he publishes, taken at varying periods after the operation, his results may fairly be described as excellent.

Mr. Stiles gives detailed descriptions of the best incisions for the operation, which he has performed upon all the long bones except the femur. Certain precautions are necessary in the after-treatment; for instance, after removal of the shaft of the humerus an extension must be applied, while the new bone is being formed, to prevent shortening, and in the case of the other long bones any tendency to malposition of the hand or foot towards the side of the affected bone must of course be corrected, or even slightly over-corrected during convalescence. This operation is only justifiable in cases of genuine osteomyelitis, *i.e.*, where the disease is situated in a central portion of the bone. If the diseased area can be seen by skiagraphy to be in the superficial portion of the shaft, under the periosteum, and does not extend centrally into the medulla, the treatment should be identical with that which has already been described under the heading of Tuberculous Epiphysitis, since in this case the whole diseased area can be removed and a healthy continuous bone left behind.

3. *Tuberculous Periostitis.*—In this form the disease starts just underneath the periosteum, the infection being either of the periosteum itself or of the superficial layers of the shaft of the bone. It is more commonly found in the ribs than elsewhere. A definite sub-periosteal abscess has usually formed before the patient seeks advice. It is often sufficient to make a straight incision over the swelling, incise the periosteum, and evacuate the pus. If there is no obvious caries of the exposed bone this will be sufficient to effect a cure. It is unnecessary to insert a drainage tube; the wound should simply be sewn up. It is to be presumed that the removal of the caseous material allows the bactericidal power of the patient's serum to come into play, so that any remaining tubercle bacilli are killed. If the rib itself is macroscopically diseased the whole of the affected portion should be removed by cutting the rib through in two places with bone-forceps, in the same way as is done in dealing with an empyema, and this must always be done in those cases in which the abscess lies deep to the rib, *i.e.*, between the rib and the parietal pleura, since only in this way can it be made certain that the whole abscess is evacuated.

The operative treatment of tuberculosis of the bone is often complicated by the fact that there are superficial sinuses leading down to the diseased bone when the surgeon first sees the case. These are almost invariably septic, a matter which will hardly cause surprise when the difficulty of keeping such sinuses aseptic even under the best possible conditions is remembered. Any such sinuses should be completely dissected out and their edges pared away wherever possible before the actual focus in the bone is dealt with. Unless this is done it is hardly possible to get a satisfactory result, since the tuberculous granulation tissue in the sinus wall will prevent healing of the wound.

It must be added that the treatment of tuberculous disease of bone does not end with the operation. It has long been recognised that nothing is more important in the treatment of pulmonary and other forms of tuberculosis than good general hygienic surroundings and suitable diet. It is equally important when this disease attacks the skeleton.

After the operation the patient should spend as much time as possible in the fresh air, preferably in the sunshine. The diet should be generous and should consist of as much fatty food as the patient will tolerate. Of medicinal forms of treatment cod-liver oil is the most efficient.

Healing is undoubtedly accelerated in the majority of cases by inoculation with small doses of Koch's new tuberculin. The dose which has the maximum therapeutic effect in any given case varies greatly. But it can be found empirically by starting with a very small dose, such as $\frac{1}{40000}$ milligramme. Whether the patient is reacting to tuberculin or not can only be told by taking the tuberculo-opsonic index at regular intervals, and the dosage must be regulated in accordance with this. If a septic sinus exists the staphylococcus must be isolated and a vaccine prepared from it, which must be administered alternately with the tuberculin (*see* Vaccine Therapy, Vol. III.). Some surgeons have reported cases of sinuses which have resisted all other forms of treatment but have closed after injection with gelatine containing bismuth salts.

Actinomycosis hardly ever attacks any other bone than the mandible (*see* Diseases of the Jaws, Vol. II., and Actinomycosis, Vol. I.).

A hydatid cyst may occur in the shaft of a long bone; but it is so rare as to be a surgical curiosity. Its presence is rarely suspected until the bone is fractured by a disproportionately small injury. It is almost impossible to obtain union and such cases as have been recorded have ended in amputation.

TUMOURS OF BONE.

Simple Tumours.—The most common of these are called exostoses, but the name is a bad one. They are really osteomata, and are divided into (*a*) cancellous osteomata and (*b*) ivory osteomata, according to their histology.

Cancellous osteomata are composed of spongy bone, and are generally found in the neighbourhood of epiphyseal lines. They often cause no symptoms, advice being sought merely on account of the presence of an abnormal protuberance. But occasionally they give rise to inconvenience because the overlying structures become irritated. If this is the case it is justifiable to excise them, but before proceeding to operation, several points must be borne in mind: 1. The ends of all the long bones should be examined, since the condition is frequently multiple; 2. It is better to wait until the time when the epiphysis unites with the shaft in case the epiphyseal line is damaged at the operation and subsequent growth of the bone is inhibited; 3. There is a slight risk attached to the operation, it being said that cancellous osteomata occasionally become sarcomatous after operation.

The operation consists in making an incision over the swelling and exposing it thoroughly. These osteomata are nearly always pedunculated, but it is not sufficient merely to chisel away the growth so that its base is flush with the surface of the bone. The whole base should be chiselled out to a depth of ¼ inch. Unless this is done there is a liability to recurrence.

Cancellous osteomata are most frequently found over the epiphyseal line above the internal condyle of the femur.

"Rider's bone" is a condition which occurs in this situation, and somewhat resembles a cancellous osteoma, but is really an ossification of some of the fibres of insertion of the adductor magnus. The treatment is that described above.

Ivory osteomata are composed of dense bone and rarely occur except in the cranial bones. They are sometimes, however, found in the infraspinous fossa of the scapula. If they inconvenience the patient or interfere with his occupation, as they may do, for instance, when they occur in luggage porters, it is well to cut down on them and chisel them away. The operation is often a difficult one, because these tumours are composed, as has been said, of dense bone and are generally sessile in form.

A *subungual exostosis* is a painful bony excrescence occurring under the big toenail. It is usually inflammatory in origin and consists of a dense periostitis. The nail should be removed, and the bony excrescence nipped off with bone forceps.

Chondromata commonly occur in the bones of the hand and foot. They are usually multiple and may grow from the interior or exterior of the bone. In the hand they should be removed with the aid of a chisel, and their base gouged out. They may recur, and the operation will have to be repeated. Amputation of a finger should only be resorted to after several attempts to remove the tumour have failed or if the microscope shows any suspicion of malignancy. Toes, however, may be amputated for this cause with less compunction. It is wise to bear in mind that gouty deposits may bear a striking resemblance to multiple chondromata of the hand.

Malignant Tumours.—(*a*) *Myelomata* are in a class by themselves. They are only locally malignant and do not tend to form metastatic deposits nor endanger the life of the patient. Further, if they are thoroughly removed they do not tend to recur. The commonest situation for a myeloma is the upper end of the tibia, though any of the long bones may be affected. The disease is sometimes seen in a multiple form in the mandible (*see* Diseases of the Jaws).

Until comparatively recent times amputation was the routine treatment for this condition, but since it has been definitely proved that the growth does not recur after thorough removal, successful attempts have been made to save the limb. Conservative treatment is not justifiable unless the diagnosis has been made absolute by a microscopic examination of a portion of the growth removed at a preliminary operation.

If the disease is situated in the radius, ulna or fibula, the whole of the affected portion may be resected sub-periosteally, in the same manner as was described for tuberculous osteomyelitis. But if the humerus, femur or tibia is attacked, this method is not practicable.

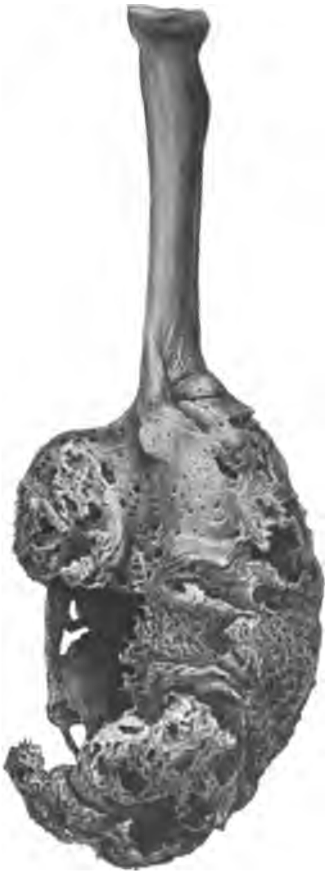


FIG. 3.—Myeloma of lower end of Radius—too extensive for conservative treatment.

In the former case the treatment must be decided according to what is found at the time of operation. If the myeloma is not so extensive as to involve the whole circumference of the bone, and is contained in a cavity from which it can be completely enucleated, as occasionally it is in the upper end of the tibia, the best results are obtained by filling the cavity with the stopping introduced by von Mosetig Moorhof, of Vienna. Mr. Burghard, in his " System of Operative Surgery," describes the technique as follows: The stopping consists of a " sterilised iodoform wax (iodoform, 60 parts ; spermaceti, 40 parts; and oil of sesame, 40 parts). This is heated until it is fluid, and is poured while still hot into the cavity, which has been previously scrupulously dried. It finds its way into all the crevices of the cavity, and effectually stops it, and then hardens *in situ*. The stopping should be made flush with the surface of the bone and the soft parts are then brought together over it."

Not a few completely successful results have been recorded by this method, but it is of course obviously inapplicable to cases in which a portion of the whole thickness of the tibia is involved.

Mr. Burghard quotes a case reported in the "Annals of Surgery," 1906, by Rausch and Schoweberg, in which 9 cm. of the entire shaft of the tibia were removed for myeloma. A corresponding portion of the tibia was dissected out from an amputated limb, boiled to sterilise it, and then grafted *in situ* and secured by ivory pegs. The myeloma unfortunately recurred and the limb had to be amputated, when it was ascertained by dissection that the graft had united firmly to the bone at either end, and was covered by a new periosteum.

(*b*) *Round-celled and spindle-celled sarcoma* frequently attacks the long bones. They are equally malignant and demand immediate amputation as soon as the diagnosis is made.

Here again certainty can only be obtained by microscopical examination of a portion of the growth removed by operation. Some authorities state that to incise a sarcoma for microscopical purposes necessarily disseminates the growth, and is therefore unjustifiable. The risk, if there is any, can certainly be diminished by removing a piece, having it examined microscopically at once in the theatre by the freezing method, and proceeding immediately to amputation if the diagnosis is confirmed. If this be done, sufficient time to allow of dissemination cannot possibly have lapsed.

This is not the place for a description of the technique of amputations generally; but in performing the operation it is essential to remove the whole of the affected bone always; and more than this, if the upper part of the bone is affected, the limb should be removed through the central or upper part of the bone above, if possible. When the disease attacks the upper half of the humerus, the only operation which gives any chance of a radical cure is Berger's forequarter amputation.

Much has been published, particularly in America, in favour of treating these cases with Coley's fluid. In the present state of our knowledge of malignant growths, it should never be preferred to amputation, whenever this is possible. But I think it may justifiably be tried if amputation is contra-indicated by the position or the extent of the growth.

In these cases daily hypodermic injections of small doses may be given, not more than ½ min. to start with. The injection should be made into the tissues overlying the tumour. The amount given may be gradually increased up to 5 min. or more. But sudden pyrexia or the onset of vomiting must be taken as an indication that the dose should be diminished for a time.

(*c*) *Carcinoma* never occurs in bone as a primary manifestation, but is secondary to carcinoma in some other part of the body, most often the mamma. Moreover, when it does occur, it rarely forms a tumour, but is discovered owing to an apparently spontaneous fracture. Amputation is the only treatment, unless it is contra-indicated, as it often is, by the general condition of the patient.

OSTEOMALACIA AND FRAGILITAS OSSIUM.

Osteomalacia is a condition occurring in parturient women. All the bones of the skeleton undergo softening. No medical treatment is of any avail. It seems fairly certain that the condition is ovarian in origin, and oöphorectomy holds out the only hope of cure. If the patient is pregnant abortion should be induced at once.

Fragilitas Ossium is a condition in which the bones fracture in response to almost incredibly slight violence. It is apparently congenital, but nothing is known of its pathology.

The fractures unite readily if treated in the ordinary way, but no general treatment is known.

IVOR BACK.

INJURIES AND DISEASES OF JOINTS.

DISLOCATIONS.

GENERAL TREATMENT OF DISLOCATIONS.

Recent dislocations should be reduced as soon after the accident as possible, since any delay in reduction both increases the difficulty of the procedure and also is likely to impair the subsequent functional power of the limb owing to extensive infiltration of capsular and peri-articular tissues. For reduction, anæsthesia in many cases is not absolutely necessary, except for the relief of pain; in most cases, however, muscular spasm or great pain necessitate the use of some form of anæsthetic. In some cases gas will be found to be sufficient; but if there is great muscular spasm, ether or chloroform must be used. The dangers of the deep chloroform anæsthesia required in these cases must always be borne in mind.

After-treatment.—For the first few days the limb should be absolutely immobilised; occasionally it may be found necessary to fix the limb for a longer period than this, especially if the lower extremity is affected or the ligaments have been extensively lacerated with a tendency to re-dislocation of the joint. Prolonged immobilisation, however, is to be avoided, since such a procedure is likely to produce much subsequent impairment of the movements of the joint owing to adhesions. For a short time after the accident the local application of hot Goulard and opium fomentations is useful, both for the relief of pain and to diminish the effusion. After the first few days gentle massage should be commenced, to be followed later by passive movements. The movements should be increased gradually, great care being taken to avoid re-dislocation of the joint.

Compound Dislocations.—These accidents are always serious, since the joints are almost certain to become infected, and greatly impaired movements or ankylosis are likely to follow. Suppuration occurring in one of the larger joints may necessitate amputation of the limb, especially if the patient is becoming exhausted or there is any evidence of pyæmia (*see* below under Septic Arthritis). Primary amputation may be necessary if there is extensive laceration of the soft parts, or if the main vessels or nerves are injured.

In an uncomplicated case, after carefully cleansing the surrounding skin, the wound should be enlarged, so as to give good access to the joint cavity. The dislocation is then reduced and the joint cavity freely irrigated with a weak antiseptic solution, such as biniodide of mercury (1 in 6,000). If there is any very marked contamination of the joint cavity the local application of absolute alcohol is often of use; in such cases a prophylactic dose of antitetanic serum may be given, especially if the wound area is soiled with road dirt. Free drainage must be provided for, counter-openings being made if necessary; the limb is then immobilised on a suitable splint. The wound should be irrigated daily with saline solution if there is much discharge; the tubes should be removed as soon as the discharge diminishes or ceases, as it will rapidly do if the joint is only slightly infected. As soon as the wounds have healed, gentle attempts may be made to move the joint; fair movements can be obtained in some cases, but more often, especially in cases which have suppurated freely, partial or complete ankylosis will result. If it is evident that ankylosis is likely to occur, care should be taken to keep the limb in a position which will be most useful to the patient afterwards. In some joints, *e.g.*, the shoulder and elbow, an excision will give a movable joint if freely performed.

DISLOCATIONS OF THE CLAVICLE.

Either end of the clavicle may be dislocated; the acromial end is more commonly affected.

Dislocation of the Acromial End of the Clavicle.—Two varieties are described, upward and downward. In either case, although the dislocation is easily reduced by simple traction and digital manipulation, the condition is very likely to recur.

In the first instance an attempt may be made to retain the parts in their proper position by placing a pad in the axilla and strapping the arm to the side, another pad being placed on the point of the shoulder and fixed by figure-of-eight strapping, which passes round the opposite axilla. These measures in the majority of cases fail; the question then arises as to whether the condition requires open operation and wiring. From a cosmetic point of view an operation may be advisable, but it must be remembered that there is no functional disability from an unreduced dislocation of this kind.

Dislocation of the Sternal End of the Clavicle.—Three varieties of this dislocation may occur, viz., forwards, upwards and backwards. Reduction may be easily effected by digital manipulation, the shoulders being at the same time forcibly pulled backwards. The parts are then retained in apposition by a small pad fixed over the joint by a figure-of-eight bandage, the arm being bandaged to the side with the elbow supported in a sling. Fixation in this way should be persisted in for three weeks, after which time gentle movements may be started. As in the acromial dislocation, recurrence is very likely to occur. If this happens, it may be necessary to excise the end of the bone, excision being essential if there are pressure symptoms.

DISLOCATION OF THE SHOULDER.

Owing to the shallowness of the glenoid fossa, the laxity of the joint capsule and the exposed position of the joint, the shoulder is the joint most frequently dislocated. The accident occurs most frequently in adult life and is rare before puberty. The cause is usually indirect violence from falls on the hand when the arm is abducted, the head of the humerus being then brought into contact with the weakest part of the capsule, viz., the lower and inner part, which is torn through and so allows the head of the bone to escape through the rent. The position taken up by the head of the bone depends on the direction of the long axis of the humerus at the time of the accident. There are four principal varieties of dislocation, viz., subcoracoid (the commonest), subglenoid, subclavicular, and subspinous. In addition, two very rare varieties may be mentioned, supracoracoid dislocation and luxatio erecta.

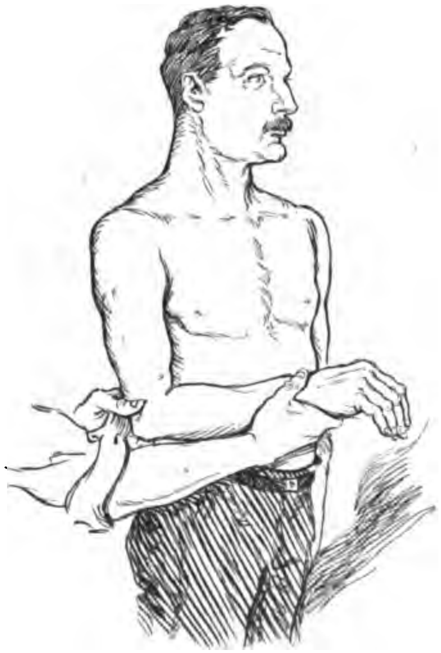


FIG. 1.—Reduction of a subcoracoid dislocation of the shoulder joint. Kocher's method, first position.

Two methods of reduction are available: (1) Kocher's method of manipulation; (2) Direct traction.

Reduction by Manipulation (Kocher's Method).—Many cases can easily be reduced by this method without an anæsthetic, if seen shortly after the accident; but in muscular patients and others who are unable to bear any manipulation owing to pain, a general anæsthetic is advisable.

If no anæsthetic is used it is best to place the patient in a sitting position in a chair, but if the surgeon is single-handed it is better for the patient to be lying on his back on a couch or bed.

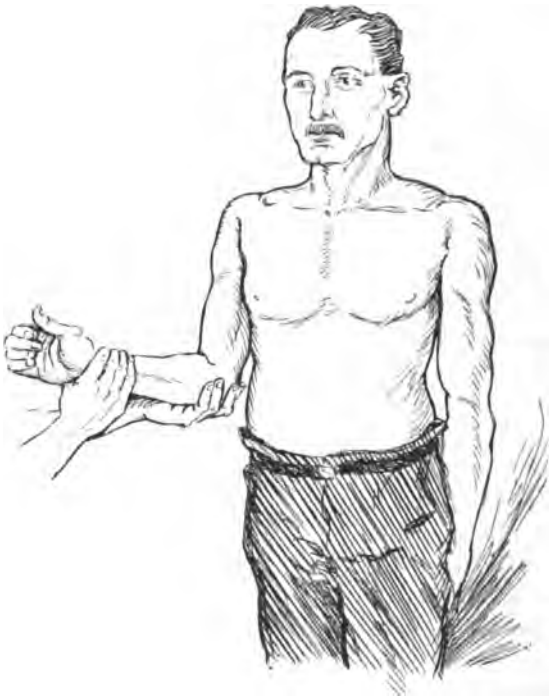


FIG. 2.—Reduction of a subcoracoid dislocation of the shoulder joint. Kocher's method, second position.

The surgeon stands in front of the patient on the affected side, and if the dislocation is of the right shoulder, he grasps the patient's right wrist with his right hand and the lower end of the humerus with his left hand. In the first place the patient's forearm is flexed to a right angle, and the arm is pressed to the side of the thorax; secondly, the arm is rotated outwards till distinct resistance is felt, and thirdly the arm is adducted and brought forwards and inwards as far as it will go, flexion and external rotation still being maintained; while lastly the arm is rotated inwards and the hand carried to the opposite shoulder, when the head of the bone will be felt to slip into position with a click. During the whole of these manipulations as much traction as possible in the long axis of the humerus should be effected by the left hand.

Reduction by the "Heel in the Axilla" Method.—The patient is placed on a couch or on the floor, and when he is fully anæsthetised the surgeon takes a seat facing him on the affected side, and placing his unbooted heel firmly into the axilla, grasps the patient's forearm and pulls at first directly downwards and then inwards, across the patient's body. In many cases downward traction of the arm is all that is required to reduce the dislocation. The traction should be gradual and continued.

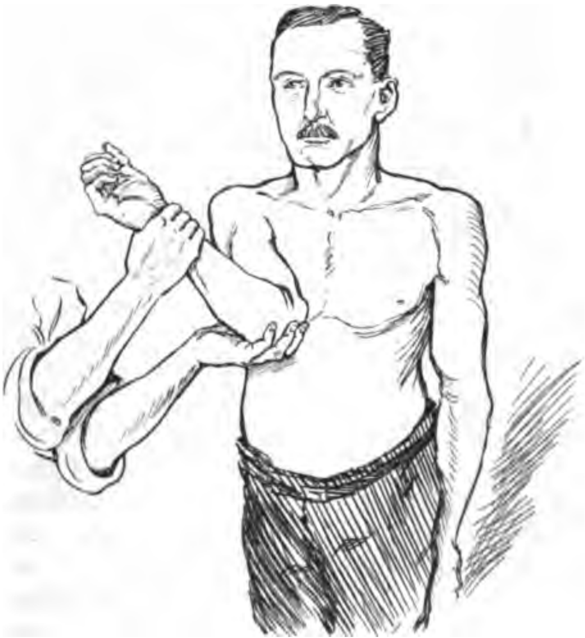


FIG. 3.—Reduction of a subcoracoid dislocation of the shoulder joint. Kocher's method, third position.

Subcoracoid dislocations are usually easily reduced by Kocher's method; the other varieties are best dealt with by direct traction, which in the case of luxatio erecta should be applied in the direction of the long axis of the humerus as it lies after the accident.

After reduction the patient should carry his arm in a sling, and if there is much effusion into the joint an evaporating lotion or hot fomentations may be applied. Early passive movement and massage should be commenced, so as to prevent adhesions forming in the joint. The patient should be warned against too free use of the limb, especially in overhead movements, as the dislocation may easily recur.

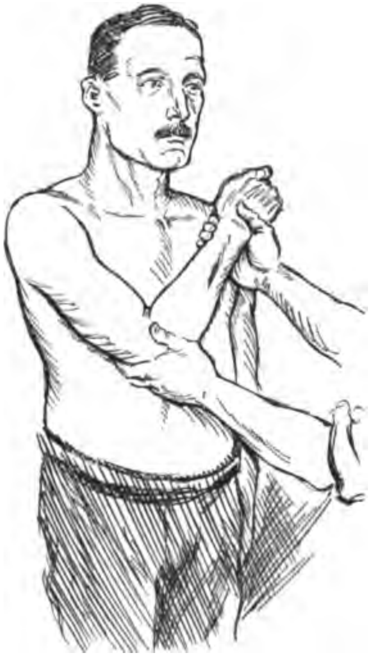


FIG. 4.—Reduction of a subcoracoid dislocation of the shoulder joint. Kocher's method, fourth position.

Dislocation of the Head of the Humerus Complicated by Fracture of the Shaft.—If a fracture of the shaft of the humerus complicates dislocation, there is no difficulty in reducing the dislocation by Kocher's method, or failing that by means of the heel in the axilla. The patient should be fully anæsthetised, and the arm after reduction put up firmly in straight splints. The fracture is then treated in the usual way.

Dislocation of the Head of the Humerus Complicated by Fracture of the Anatomical or Surgical Neck, or Separation of the Epiphysis.—The patient should be anæsthetised, and an attempt should be made to replace the head of the bone by digital manipulation; if this succeeds the case should be subsequently treated as an ordinary fracture. If replacement cannot be effected open operation is indicated with removal of the fragment or fixation with plates and screws.

Compound Dislocation of the Shoulder.—This is a rare accident, and is only caused by great violence.

An anæsthetic should be given, and the parts should be thoroughly cleaned and made as aseptic as possible. The joint should be thoroughly irrigated with a solution of biniodide of mercury (1 in 8,000), and free drainage must be ensured.

Very frequently at a later period it is necessary to excise the joint, owing to impairment of movement from adhesions or ankylosis following septic arthritis.

Rupture of the Axillary Artery or of one of its Branches, or of the Axillary Vein.—These are fortunately rare accidents, and are most likely to occur in attempts at reduction of old unreduced dislocations. The axillary artery is more often injured than the vein, and may be partially or completely torn across, in which case a pulsating swelling rapidly develops in the axilla.

Digital pressure should be applied at once to the third part of the subclavian artery. The patient should then be anæsthetised and the axilla should be opened, the clot turned out, and the torn ends of the artery ligatured, the wound sewn up and a large drainage tube put in.

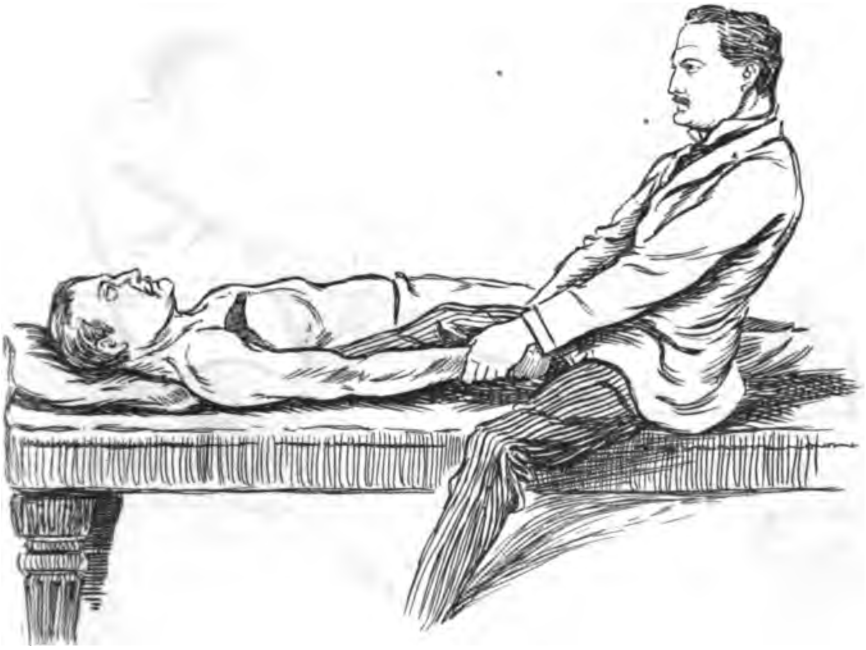


FIG. 5.—Dislocated shoulder. Reduction by the heel in the axilla. First position.

If gangrene ensues or secondary hæmorrhage develops, amputation at the shoulder-joint must be performed at once.

If the vein is torn the axilla should be freely opened, and after turning out the blood-clot the tear may in some cases be sutured; more often it will be necessary to ligature the vein above and below the tear.

Injury to the Brachial Plexus.—The brachial plexus may be either bruised or torn at the time of the accident, or it may be pressed on by an old unreduced dislocation, thus causing partial paralysis.

If only bruised there will be improvement in a few weeks' time. The arm should be kept in a sling and massage and electricity applied daily.

If the nerves are torn across an attempt should be made to suture them. (*See* Injuries to Nerves, Vol. II.)

Unreduced Dislocation of the Shoulder.—In many old-standing cases it is a question whether any attempt at reduction should be made, since there is great danger of injuring vessels or nerves, or even of fracturing the humerus if too much force is used. Furthermore, many patients have extremely useful limbs with fair range of movement. No limit of time can be given after which it is impossible to reduce a dislocation, but each case must be taken on its merits. If any attempt is made, Kocher's method, or direct traction with the heel in the axilla as described above, should be employed, great care being taken to avoid any excessive violence. If reduction cannot be effected by these methods, open operation with excision of the head of the bone will often give good results;

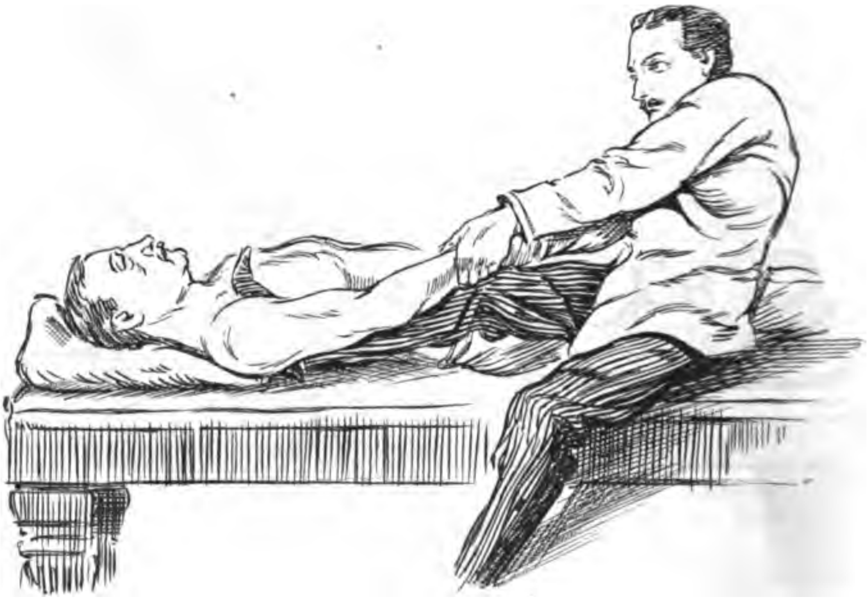


FIG. 6.—Dislocated shoulder. Reduction by the heel in the axilla. Second position.

operation is essential if there is any evidence of pressure on vessels or nerves.

DISLOCATIONS OF THE ELBOW.

These dislocations are not uncommon in patients under twenty years of age, and are very frequently complicated by fractures or separation of epiphyses.

The bones may be dislocated backwards, forwards, laterally, or in different directions, or one bone may be displaced separately. Dislocation backwards of both bones is the only dislocation which is at all common.

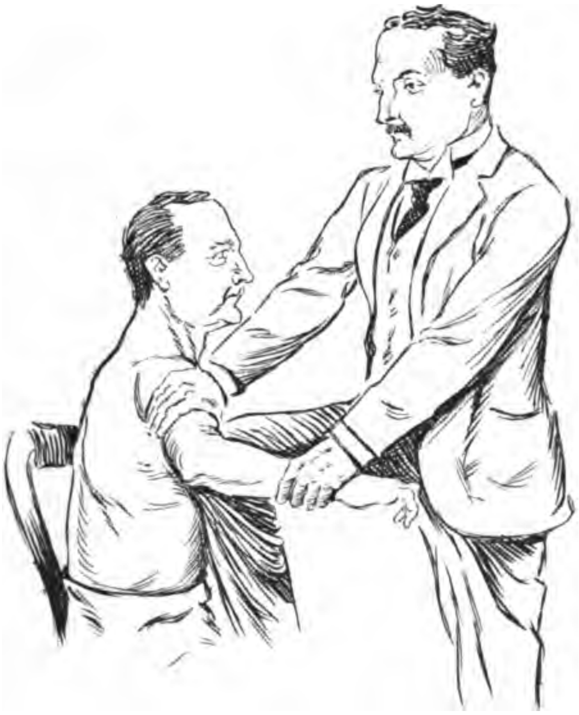


FIG. 7.—Dislocation of elbow backwards. Reduction by placing knee in bend of elbow.

Dislocation Backwards of the Radius and Ulna.—This is usually caused by indirect violence from a fall on to the palm of the hand with the forearm extended at the time of the accident. Usually there is not much difficulty in reducing this dislocation if the injury is recent.

If the surgeon is single-handed, the following method should be tried: The patient is seated in a chair, and the surgeon presses his knee into the bend of the elbow against the lower end of the humerus, grasps the patient's wrist and flexes the joint forcibly around the knee. If this should fail, an anæsthetic is given and the same method is tried again, when the dislocation will be reduced with ease. In many cases simple flexion with slight traction is all that is required.

As there is usually much swelling of the parts around the joint and effusion into it, an evaporating lotion should be applied, and the limb should be carried in a sling. Massage should be commenced within a day or two, and passive movements within a week. A fair range of movement can usually be obtained, but full extension is rarely recovered.

Dislocation of the Radius and Ulna Backwards with Fracture of the Coronoid Process.—The dislocation is reduced and the case is then treated in the ordinary way for fracture. The forearm is flexed to a right angle with the hand in a supinated position, and fixed in this position by means of a posterior rectangular splint. Passive movement and massage should be commenced in a week, great care being taken to prevent re-dislocation. (*See also* Fractures.)

Compound Dislocation of the Radius and Ulna Backwards.—In a recent case the wound should be enlarged so that the entire cavity of the joint can be efficiently cleaned with an antiseptic solution. When this has been done the dislocation should be reduced. As there is always a large quantity of synovia secreted, it is best to drain for a few days. In cases in which the bones are splintered it is advisable to excise the joint at once. In more severe injuries it may be necessary to amputate the arm.

Lateral Dislocation of Radius and Ulna from the Humerus.—The bones may be dislocated outwards or inwards. The dislocation is nearly always incomplete. The treatment is similar to that for backward dislocations.

Dislocation of the Radius and Ulna Forwards.—This occurs from a severe blow or fall when the limb is flexed; it is, however, a very rare accident. Reduction can be effected by pulling or pressing the upper end of the forearm downwards and backwards.

Unreduced Dislocation of the Elbow.—The causes which prevent the reduction of this dislocation are the interposition of pieces of muscle, fragments of bone, and cicatricial tissue, and treatment depends largely on the duration of the condition. An attempt should be made to secure reduction by manipulation under an anæsthetic. If this fails, excision of the joint should be performed rather than any attempt at reduction by open operation, since the latter procedure almost invariably results in a stiff joint.

Dislocation of the Radius Alone.—The radius may be dislocated forwards, backwards or outwards; the forward displacement is the one which most commonly occurs. This dislocation can be reduced by traction, pressure being made at the same time on the head of the bone. If this should fail, operation is indicated.

Dislocation of the Ulna Alone.—This may occur backwards, forwards or inwards, the backward displacement being the most common form. The treatment is the same as that for both bones backwards.

DISLOCATIONS OF THE WRIST AND FINGERS.

Dislocation of the Wrist-joint.—Dislocation of the wrist-joint without a fracture is a very rare occurrence; it is caused by a fall on to the palm of the hand or by a blow on the back of the hand. The displacement may be either backwards or forwards, the backward displacement being the more common.

Reduction is easily effected by traction. There is usually much effusion into the joint and around it. It should, therefore, be placed on a splint for a short time, but free movement of the fingers should be allowed. An evaporating lotion may be applied. Passive movement and massage should be commenced at the end of the week.

Dislocations at the Metacarpo-phalangeal Articulations.—These dislocations are not of frequent occurrence. Dislocation of the proximal phalanx of the thumb backwards is the most frequent.

In most cases simple traction with manipulation will effect reduction. An instrument known as an "Indian puzzle" may be used to grasp the thumb, and is often extremely useful in order to obtain sufficient traction. In some cases, however, it is impossible to reduce the dislocation owing to the flexor longus pollicis tendon surrounding the neck of the bone. If this is the case, reduction by open operation is indicated.

Dislocations at the Inter-phalangeal Joints.—These dislocations occur from falls on to the fingers, and are not uncommon amongst cricketers in attempting to stop a hard-hit ball. They are easily reduced by traction and pressure; but it must be remembered that a considerable degree of subsequent disability owing to stiffness is sure to result.

If the dislocation is compound, the parts should be made aseptic, and the dislocation is reduced by traction; a dressing of double cyanide gauze is then applied.

DISLOCATIONS OF THE HIP.

There are four principal varieties: Dorsal, sciatic, thyroid and pubic.

Dorsal Dislocation.—This dislocation may be reduced by (1) Manipulation, (2) Traction, (3) Pulleys.

(1) *Manipulation* (*Bigelow's Method*).—The patient should be placed on the floor or on a low couch, and should be fully anæsthetised. The pelvis must be firmly fixed by an assistant. The surgeon should stand on the affected side and grasp the patient's ankle with one hand and the upper end of the tibia with the other; the thigh is now fully flexed on the abdomen and the leg on the thigh, at the same time the limb should be slightly adducted and rotated inwards in order to disengage the head of the bone from behind the acetabulum. The limb is now abducted and rotated outwards, then circumducted and brought down parallel with the opposite limb, when the head of the femur will be felt to slip into the acetabulum.

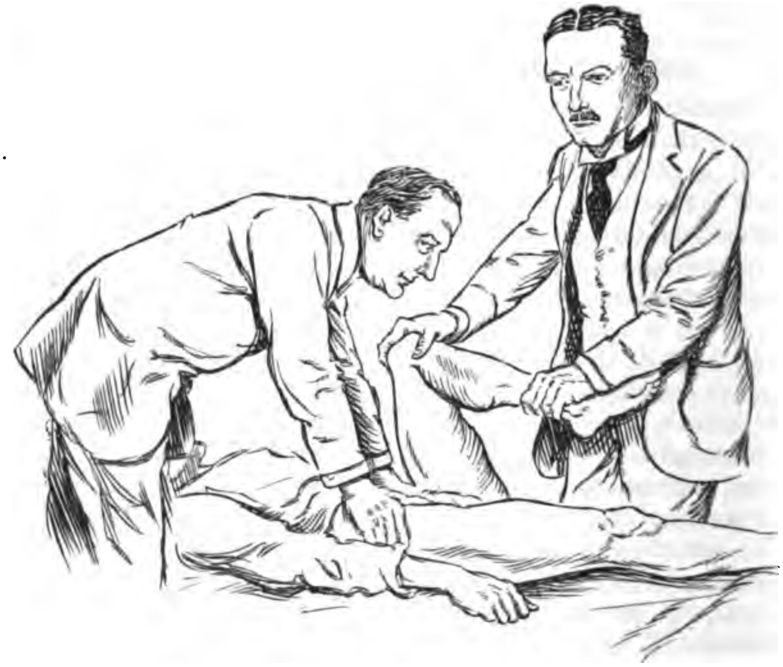


FIG. 8.—Dorsal dislocation. Bigelow's method. First position.

(2) *Reduction by Traction.*—The patient should be placed on the floor or on a low couch and anæsthetised. The surgeon should then flex the leg on the thigh and the thigh on the abdomen, then

adduct or rotate inwards slightly to disengage the head of the femur from behind the acetabulum. The surgeon's foot, divested of its boot, should be placed on the anterior superior spine to steady the pelvis whilst he steadily pulls directly upwards on the flexed knee.

(3) *Stimson's Method of Reduction by Traction.*—A method for the reduction of dorsal dislocations which is strongly recommended by many American surgeons is to place the patient with his face downwards on a table, with the thigh hanging over the edge at angles right to the body and the leg flexed at a right angle to the thigh, the necessary traction being made by the weight of the limb itself; if this is not sufficient a sandbag may be placed on the calf, or downward pressure may be made by the surgeon's hand.

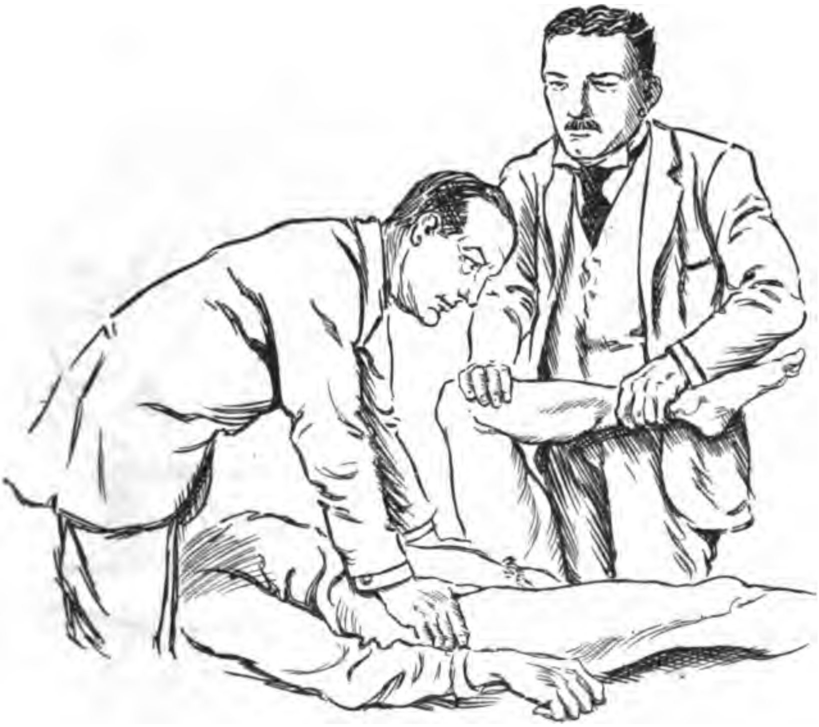


FIG. 9.—Dorsal dislocation. Bigelow's method. Second position.

Sciatic Dislocation.—The patient should be anæsthetised, and the leg should be flexed on the thigh with extreme flexion of the thigh on the abdomen, at the same time the limb should be abducted and externally rotated, slight upward traction being simultaneously performed in the long axis of the femur.

Thyroid Dislocation.—Reduction by rotation (Bigelow). The leg is flexed on the thigh and the thigh flexed to right angles and slightly abducted; it is now rotated inwards and adducted and brought down by the side of the opposite limb whilst rotation inwards is maintained. If the surgeon fails to reduce a thyroid dislocation, Bigelow recommends that it should be converted into a dorsal dislocation and reduced by the method advised for a dorsal dislocation.

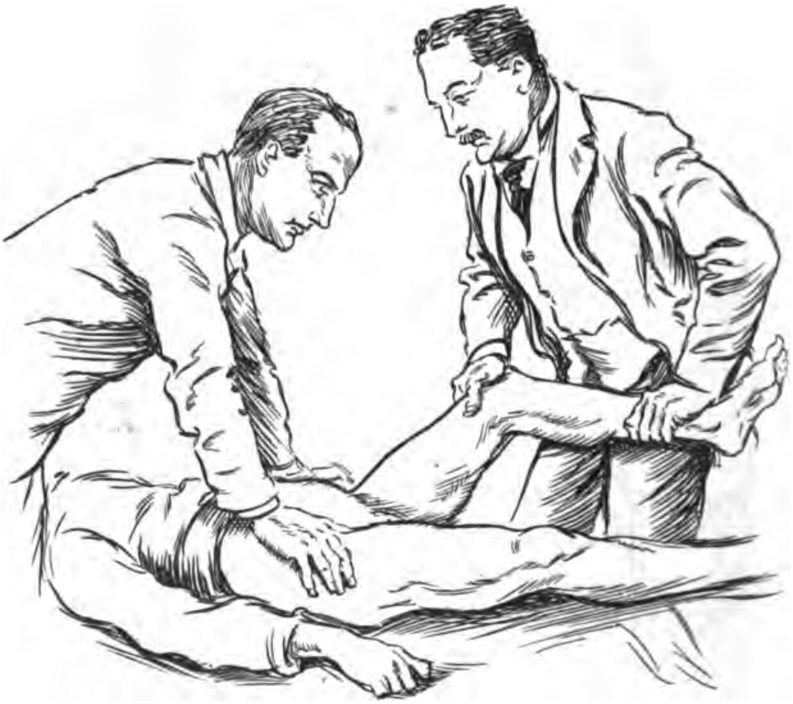


FIG. 10.—Dorsal dislocation. Bigelow's method. Final position.

Pubic Dislocation.—The patient should be anæsthetised, the thigh is flexed to a right angle whilst being drawn down. With slight internal rotation and abduction the limb is brought inwards and downwards by the side of its fellow.

Irregular Dislocation of the Hip.—In this dislocation the Y-shaped ligament of Bigelow is torn completely, and in some cases the rim of the acetabulum is broken off.

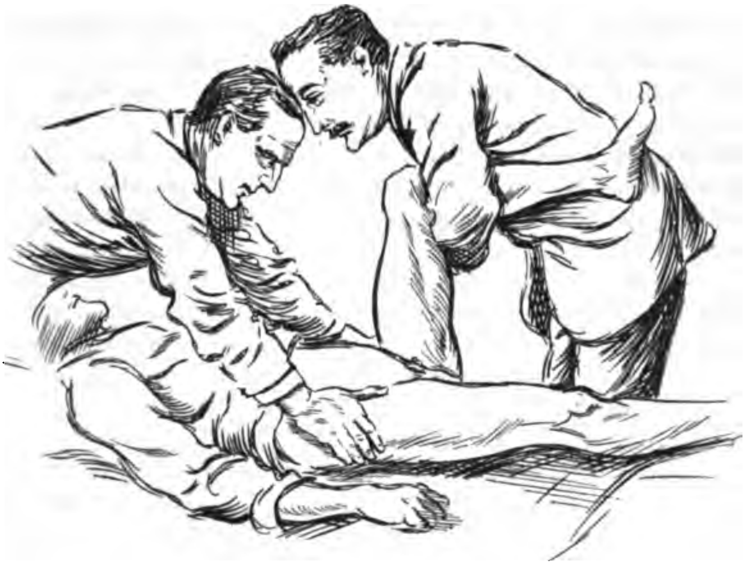


FIG. 11.—Dorsal dislocation. Reduction by traction.

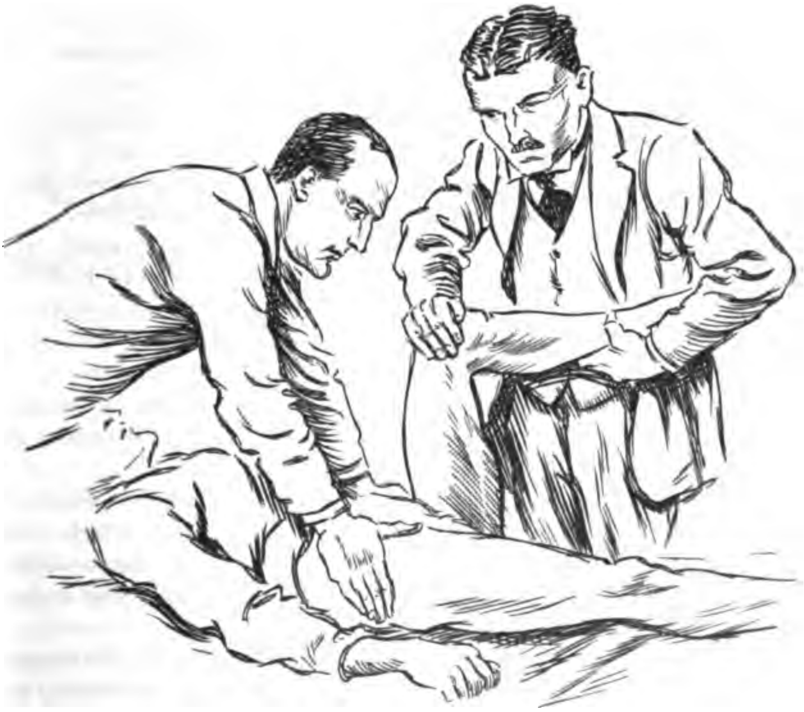


FIG. 12.—Thyroid dislocation. Bigelow's method.

An anæsthetic should be given, and traction made on the thigh with rotation inwards or outwards. After reduction the limb should be fixed by a Dessault splint for at least a month, after which passive movement should be commenced.

Unreduced Dislocations of the Hip.—In unreduced dislocations the period during which reduction is still possible is determined by the extent of the obliteration of the acetabulum, the strength of the neck, and the absence of bony excrescences. If manipulation under an anæsthetic fails to reduce the deformity it is often best to take no further steps, as in many cases the patient gradually recovers the movement of the limb in a very marked degree. In some cases excision of the head may have to be performed, especially if the unreduced dislocation prevents the patient from walking in the erect position.

Compound Dislocation of the Hip.—This is fortunately a rare condition but is a very serious accident. Primary amputation should not be performed. The joint should be thoroughly cleaned out with an antiseptic solution, and free drainage should be established. If there is much splintering of the head of the bone, excision should be performed.

DISLOCATIONS OF THE KNEE AND THE SEMI-LUNAR CARTILAGES.

Dislocations of the Knee.—Dislocation may occur forwards, backwards, inwards or outwards, and is due to severe violence. The dislocation may be complete or incomplete; the lateral dislocations are usually incomplete and the anterior or posterior complete.

Reduction is easily effected. The patient is anæsthetised; the femur is then firmly held by an assistant, and extension is made by pulling on the leg; at the same time the surgeon exerts pressure on the head of the tibia and flexes the leg on the thigh. After reduction the limb should be put on a back splint with a foot-piece; owing to tearing of ligaments and laceration of soft parts there is usually a large effusion of blood and lymph into and around the joint; an evaporating lotion should therefore be applied.

In about three weeks' time careful passive movement should be commenced, with massage of the muscles of the leg and thigh. In two months' time a leather splint should be fitted and the patient is allowed to get up. In from three to four months the leather splint may be dispensed with.

Dislocations of the Patella.—The patella may be dislocated outwards, inwards, upwards or edgeways. These accidents are caused by muscular action or by direct violence.

Dislocation outwards.—This dislocation is said to occur more frequently in patients with knock-knee: it can be reduced by flexing the hip-joint, extending the knee, and pressing the patella inwards. As a rule an anæsthetic is unnecessary.

Dislocation inwards.—This dislocation is very rare, and when it occurs is due to direct violence. The treatment is the same as for outward displacement, with the exception that the patella is pressed outwards.

Edgeways or Vertical Dislocation.—This dislocation is caused by a blow. The outer edge of the bone rests on the condyles and the inner edge is under the skin; this is the most common variety, but cases have been described in which the inner edge of the patella has rested on the condyles.

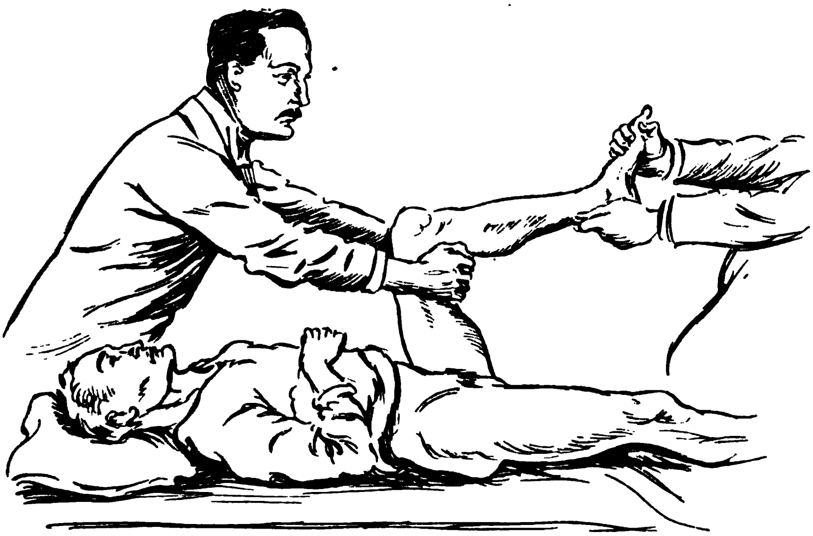


FIG. 13.—Reduction of dislocation of the knee.

Under an anæsthetic reduction can be easily effected by manipulation. Cases have been reported where manipulation has failed, and it has been found necessary to reduce the dislocation by open operation.

Dislocation upwards.—Displacement of the patella upwards is a rare accident, and can only occur by tearing or rupture of the ligamentum patellæ or by fracture of the bone, a small piece of which remains attached to the ligament.

If the ligament is torn it should be united by means of fine silk. When the bone is fractured it should be united by means of silver wire, a proceeding which has been fully described under Fractures of the Patella.

Internal Derangement of the Knee: Dislocation of the Semilunar Cartilages.—This condition is caused by a sudden twist or wrench when the knee is slightly flexed with the leg rotated inwards or outwards and the foot firmly fixed on the ground. Acute pain is at once felt and the patient is unable to fully extend the leg.

Treatment of a recent case of displacement of semilunar cartilages.—In many cases it is necessary to anæsthetise the patient. The leg should be flexed and rotated inwards (if the internal semilunar cartilage be affected) and outwards if (the external cartilage be at fault), and then suddenly extended; if the cartilage can be felt, pressure may be applied to it whilst the movements are being carried out. Reduction of the dislocation is indicated by full extension of the leg becoming possible. .

After reduction a back splint should be applied, and when the effusion has been absorbed it is necessary for the patient to wear some form of knee-splint (*see* below) for at least three months; this should be worn both by day and night. Passive movement and massage should be continued during these three months.

Treatment of chronic or recurring displacement of the semilunar cartilages.—If dislocation of the cartilage recurs after the original accident, palliative treatment may be tried. This consists in persistent massage and exercises applied to the joint over a period of some months, in order to restore as far as possible the tone and strength of the joint. In addition to these exercises the patient must be warned that certain movements are likely to produce a recurrence of the dislocation; such movements are especially those involving rotation at the knee-joint, the foot being held fixed at the time of the rotation. These particular movements must be carefully avoided, and to enable this to be more effectually carried out a number of splints have been devised. The main object of all splints for this condition is to prevent any rotation at the knee-joint while in no way limiting flexion and extension. If in spite of great care the cartilage continually re-dislocates, or if the patient wishes to indulge in hard exercise, such as football, etc., operative interference is indicated. Operation is essential if the joint is becoming weakened by repeated effusion into the synovial cavity or if full extension cannot be obtained.

Operation.—The skin of the limb should be prepared with the greatest care.

A semilunar incision between 2 and 3 inches long is made on the inner side of the joint; the flap thus formed contains skin and fascia. A vertical incision is now made through the capsule and the joint is exposed. Some surgeons prefer a transverse incision through the capsule, but this may cause subsequent weakness of the joint. The whole of the cartilage should be removed by means of curved scissors. The capsule should be carefully sutured with fine catgut, and the skin edges are united with fishing gut; no drainage tube need be used. A back splint with a foot-piece should be applied till the stitches are taken out in about ten days' time, when massage and passive movements should be commenced.

DISLOCATIONS OF THE ANKLE.

Dislocation Backwards.—This dislocation is usually caused by indirect violence, as from jumping off a carriage or motor-bus in motion. It may be partial or complete.

The patient should be anæsthetised; the thigh should be flexed on the abdomen and the leg on the thigh. Counter-extension is then made by an assistant. The surgeon grasps the foot with both hands and pulls the foot forwards and upwards; reduction occurs as a rule without any difficulty. Occasionally it is found necessary to divide the tendo Achillis.

After reduction the foot should be put up on a back splint with a foot-piece and side splints. The surgeon should take the greatest care to prevent the heel from dropping backwards. Massage and passive movement should be commenced in a few days.

In most cases the patient may be allowed to walk in from eight to twelve weeks after the accident. When the limb first assumes a vertical position there will be considerable œdema of foot and ankle, and in some cases it will be many months before this œdema finally disappears.

Dislocation Forwards.—This is a very rare form of dislocation. In recorded cases it has been found that all attempts at forcible reduction, even under anæsthesia, have failed until tenotomy of the tendo Achillis had been performed.

Dislocation Upwards.—This also is a rare form of dislocation. The astragalus is forced up between the tibia and fibula, and the cause is usually a fall on to the soles of the feet from a height.

Reduction may be brought about by forcible extension under anæsthesia.

Lateral Dislocation.—Complete lateral dislocations are always combined with fracture of the fibula and tibia, and the treatment has been described in the section on Fractures in the neighbourhood of the ankle-joint.

Compound Dislocations of the Ankle-joint.—These dislocations are always serious. In cases complicated with extensive laceration of the soft parts and splintering of the bones, or if the patient is of advanced age, amputation should be performed, but otherwise an attempt should be made to preserve the limb.

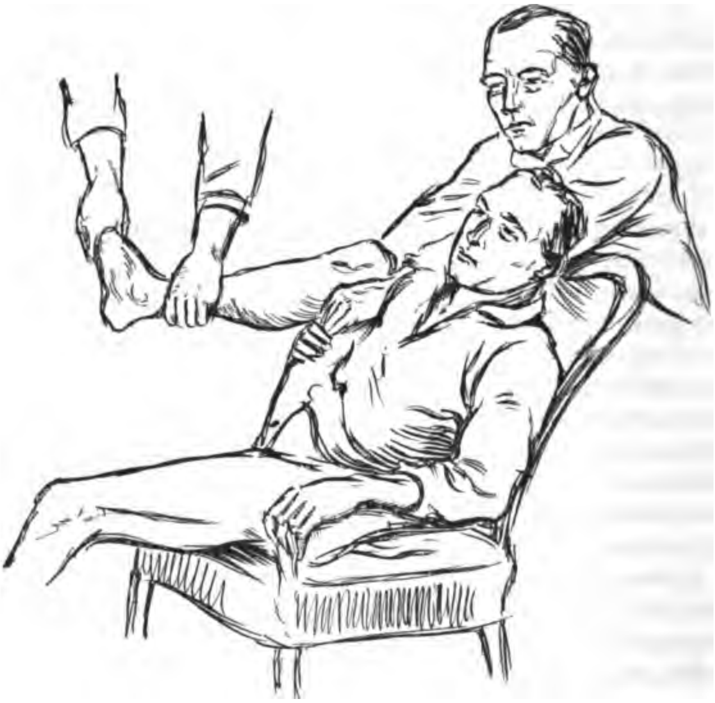


FIG. 14.—Sub-astragaloid dislocation of the foot. Backwards.

The parts should be carefully cleaned and irrigated with some antiseptic, such as biniodide of mercury (1 in 8,000), splintered pieces of bone should be removed, the wound enlarged, and the dislocation reduced; a counter-opening should be made, and, if possible, constant irrigation should be carried out with warm saline.

If this treatment fails and acute diffuse inflammation follows, with sloughing of the soft parts around the joint combined with serious constitutional symptoms, amputation should be resorted to at once.

DISLOCATIONS OF THE FOOT.

Dislocations of the Astragalus.—These dislocations are caused by heavy falls upon the foot when it is extended. They may be complete or incomplete.

Incomplete Dislocation Forwards and Outwards.—This dislocation is the one which occurs most frequently. Under anæsthesia the leg is flexed on the thigh in order to relax the calf muscles, and the thigh is firmly held by an assistant; a second assistant pulls on the foot, and the surgeon pushes the bone back into its place. In some cases it is necessary to divide the tendo Achillis and the tendon of tibialis posticus.

Complete Dislocation Forward.—In most cases it is found impossible to replace the bone, and if it is left unreduced the skin will slough; immediate excision of the bone is therefore recommended. When the wound has healed and the swelling has disappeared, the foot should be put up in plaster of paris and kept in this for about a month, after which time movement should be commenced.

Sub-astragaloid Dislocation of the Foot.—In this dislocation the astragalus still articulates with the tibia and fibula, but is separated from its articulation with the os calcis and scaphoid, which with the foot may be displaced inwards, outwards, backwards or forwards.

The patient should be given an anæsthetic; the surgeon should flex the leg on the thigh and the thigh on the abdomen; then counter-extension is made by an assistant firmly holding the thigh; the surgeon now pulls the foot in the desired direction. After reduction an evaporating lotion is applied and the limb is put up in a back splint with a foot-piece. Passive movement and massage are commenced in a few days.

Dislocations of the Tarsus, Metatarsus, and Phalanges.—These dislocations are rare, and may be reduced by traction and manipulation.

FRANCIS JAFFREY.

WOUNDS OF JOINTS.

Punctured Wounds.—A punctured wound of a joint will be recognised by the escape of synovia. On no account should a probe be used to explore the puncture, for fear of introducing septic material into the joint cavity. The surrounding skin should be thoroughly cleansed and all hair shaved off, the puncture being protected with a pad of gauze; the skin around it is then washed with soap and water, followed by turpentine or ether, and biniodide of mercury (1 in 500). It should then be dressed with double cyanide gauze, and the limb should be placed on a splint. The case should be watched very carefully during the first forty-eight hours for any serious rise in temperature, or pain, or swelling and redness of the joint; the dressing is changed after twenty-four hours. In the ordinary course of events healing should be complete in a week, when the splint should be left off and passive movement and massage commenced. If suppuration occurs, treatment should be carried out on the lines indicated below.

Incised Wounds.—In a large incised wound of a joint every possible care should be taken to render the joint aseptic. As in a punctured wound, the cut should be protected whilst the hair is being shaved off and the skin sterilised; the wound is now inspected and cleansed, and the joint is then washed out with a solution of biniodide of mercury (1 in 1,000), followed by a solution of the same fluid of a strength of 1 in 8,000. A drainage tube should be inserted. If the wound be very large some stitches should be put in, but not so many as to prevent free drainage. It should be dressed daily. If there be no complication by the end of a week, the tube may be left out and the superficial wound allowed to heal.

Lacerated Wounds.—These may be caused by machinery accidents, or by the passage over the joint of a cart-wheel or of a motor-car. There is usually much laceration of the soft parts covering the joint; dirt, mud, grease or even fragments of clothing may be forced into the joint.

An anæsthetic should be given, and the surrounding skin should be made sterile. If necessary, the wound should be enlarged so as to allow inspection of the whole of the joint and to permit of free irrigation.

The lacerated portions of the skin and cellular tissue should be cut off with scissors and the wound freely irrigated with 1 in 1,000 biniodide of mercury, followed by the same solution of a strength of 1 in 8,000; counter-openings should be made if necessary and drainage tubes inserted. If it can be carried out, constant irrigation is to be recommended. The chief dangers of this class of injury are suppuration, spreading traumatic gangrene, and tetanus ; the first two usually show signs within forty-eight hours, while tetanus may begin from the fifth day onwards.

Gunshot Wounds.—These are not common in civil practice. *The hip and shoulder-joints* are so well covered with muscles that they are rarely wounded except as the result of gunshot injury. Primary amputations of these joints are to be avoided owing to the high mortality; excision is to be preferred. The wound is enlarged, and all fragments of bone removed; free irrigation and free drainage are indicated.

Gunshot wounds of *the elbow and ankle-joints* are very likely to be followed by partial or complete ankylosis; all fragments should be removed, and treatment pursued as described for lacerated wounds. The elbow-joint in case of ankylosis should be fixed at right angles with the thumb pointing to the face, that is to say, midway between supination and pronation. The ankle-joint should be fixed at a right angle.

Gunshot wounds of *the knee-joint* are among the most serious wounds to be dealt with by a surgeon. The surrounding skin should be treated as described for punctured wounds. If much splintering of bone with injury of the large blood-vessels occurs, primary amputation is indicated.

If the joint is hopelessly damaged, the leg should be amputated as soon after the accident as possible.

Suppurating Wounds of Joints.—Suppuration may be caused from any of the above-mentioned injuries, and once it is fully established, much will depend on the patient's age and the state of health as to the treatment which should be adopted. In feeble old people or chronic alcoholic patients the best chance will be immediate amputation above the joint. If an attempt is made to save the joint, free incisions should be made into it at the most dependent part, and free irrigation practised with a solution of biniodide of mercury (1 in 8,000). The limb should be fixed on an interrupted splint.

Continuous irrigation should be carried out with either plain water, a weak solution of boracic acid, or a very dilute solution of permanganate of potash. If the case does well and the constitutional symptoms subside, the joint should be placed in such a position that if ankylosis occurs the limb may afterwards be in the most serviceable position for the patient.

If, in spite of this active treatment, the case does not do well and severe constitutional symptoms continue, secondary amputation above the joint should be performed without delay.

FRANCIS JAFFREY.

SPRAINS.

A SPRAIN has been described as an incomplete dislocation and is said to occur when a joint has been wrenched with sufficient force to overstretch or rupture the controlling ligaments and tendons. It may vary from a condition where the joint is completely incapacitated to a mere deviation from the normal where pain is only elicited by some particular movement. For many years text-books made but scant reference to the treatment of these common injuries; yet the disability caused by them often persists long after all active trouble has subsided. This may possibly be due to a patient dispensing with skilled attendance in favour of domestic remedies, once assured that no fracture or dislocation has been sustained. Treatment should be directed, not only to the relief of the immediate pain, but to the prevention of those common sequelæ, weakness and stiffness of the joint. Nowadays surgeons have discarded the old method of rigid rest in dealing with these cases; though rest is usually advocated for a few days, it is accompanied by massage and passive movements, which, provided that the services of a skilled rubber can be obtained, should be at once commenced.

The massage in the early stages should be of the lightest variety and should consist of gentle stroking movements from above the joint towards the trunk. These movements not only assist absorption of the extravasated blood and lymph, but by relieving the pressure on the sensory nerves will diminish the pain, and should be performed daily for a period of about twenty minutes to half an hour.

As the swelling subsides the massage may become firmer and include the joint in the general rubbing. Violent massage will do more harm than good, and unless the rubber can be depended upon to adhere strictly to the directions given, it is wiser to wait till swelling has practically subsided.

In addition to the massage, the local application of cold or heat for the first few hours, as a check to further swelling, is usually recommended.

The choice of heat or cold depends largely on the situation of the injury. Unless contra-indicated, cold will be found most suitable in such injuries as sprains of the knee, ankle or wrist, whilst heat is more applicable to such positions as the shoulder, hip or lumbar region.

Cold seems to be more effective in sprains of a joint, whilst heat appears to give more relief when the injury is confined to a tendon or muscles.

Ice, particularly when mixed with salt, is perhaps the best medium for applying cold, from the rapidity of its action. An indiarubber bag—the ordinary sponge bag answering admirably in an emergency—should be half filled with small pieces of ice. This must be slung so that it lightly rests on the injured joint, which should be covered by a small piece of mackintosh as a protection against the moisture caused by condensation. The patient may be allowed from time to time to remove the bag for a short period, as the intense cold produces in some people considerable pain in the limb.

When ice is not procurable, lint soaked in a mixture of spirit and Goulard lotion is an excellent means of cooling a swollen joint. The patient should have some such evaporating lotion by his side with which to wet the lint as soon as it gets dry.

The popular domestic remedy of douching by holding the injured part under the tap will be found effective in minor sprains.

Leiter's tubes are seldom used in this class of case as they are somewhat cumbersome. Their chief recommendation is that they keep the joint cool without wetting the surroundings.

In situations such as the hip or lumbar region heat can easily be applied by means of indiarubber hot-water bottles or bags of hot salt. They possess the advantages of being readily adapted to the shape of the part and of not soiling the bedding. When, however, heat is desired, and dryness of no great importance, lint wrung out in hot Goulard and opium and protected by oilsilk, will be found of great value. As a rule, the local application of cold or heat, when combined with rubbing, is rarely required after the first twelve hours.

All tendency to further swelling having subsided by these means, many surgeons advocate the application of pressure by bandaging in the intervals of the massage. The bandages should be applied evenly from below upwards, entirely enveloping the joint, whilst in addition Mr. Mansell Moullin recommends small pads of cotton-wool on any depression of the joint to ensure equality of pressure. The bandages must be adjusted with sufficient firmness to give support, but care must be taken not to cause discomfort or pain by undue tightness. As the swelling subsides the patient should be encouraged to move the injured joint voluntarily. Progress will be found to be more rapid if assistance be given to voluntary movements than if the use of the joint be confined to passive movements alone. In the course of a few days under this treatment swelling will have practically disappeared and massage can now be of a more vigorous character. It should be continued till all pain on movement has gone, the patient meanwhile being permitted to take the injured joint into general use.

It may be taken as an axiom that the muscles in connection with a sprained joint will waste. By means of massage and early movement atrophy is to a large extent obviated, but even then on comparison with the uninjured side a difference in the bulk and tone of the muscles will be detected. This wasting, which is mainly due to reflex action, will usually be righted by ordinary use, but when a marked difference be found between the two limbs, or the patient complains of instability of the joint, further treatment will be necessary.

Galvanism and faradism are methods commonly adopted to remedy this condition, and are especially useful when the atrophy is due to some definite nerve lesion. When, however, the wasting is merely due to the accidental effects of a sprain, the stimulus received from the mind for the voluntary action of the muscles is preferable. This treatment should consist in the patient performing some simple exercises by means of weights and pulleys which offer graduated resistance to the muscles.

The resistance should not be sufficient to cause strain or unnecessary effort; therefore, to commence with, care must be taken that the weights are light and that every movement is easily performed. These exercises, which can be done with a Benson, Foot, Dow or similar machine, should be carried on daily till the muscles have fully developed, the patient in the meantime artificially supporting the injured joint for ordinary purposes by means of a bandage.

Such are the broad outlines of the methods nowadays adopted for the immediate treatment of recent sprains; but it frequently happens that advice is not sought till all active trouble has subsided and relief is required for some old-standing or recurring sprain. When there is merely stiffness and weakness from disuse the application of radiant heat combined with massage and exercises will usually effect a cure. Occasionally, however, the disability is due to the formation of adhesions in or around the joint. It will then be necessary to break these down under an anæsthetic before a cure can be achieved. In such cases some surgeons advocate, for a few days, preparatory treatment by steaming and kneading the affected joint. Dr. Wharton Hood states that he never found this to be necessary or make any appreciable difference in the result. An anæsthetic is needed not so much for the relief of pain as to ensure total relaxation of the muscles. By dispensing with an anæsthetic the difficulty of the operation is increased, since it will be necessary to overcome muscles which the patient will involuntarily put into action, or which have become contracted for the protection of the joint, before the adhesions can be satisfactorily ruptured. It is for much the same reason that laughing gas should not be administered unless combined with ether.

When anæsthesia is established and the muscles thoroughly relaxed, put the joint through its movements, but not necessarily to their full extent, taking care to avoid sudden jerks or undue violence. It is also advisable to seize the limb just above and below the affected joint, for though by grasping further down the limb a stronger leverage is obtained, still it is as well to bear in mind that there are other structures that may be broken besides adhesions, whilst in the young there is the danger of separating the epiphyses. An important point to bear in mind is that after-pain is certain to be present in varying degrees; this will pass off in the course of an hour or so, and if sufficient care has been taken to avoid undue violence, no fear need be felt as to inflammation being set up. Within a few hours of the operation the joint must be gently massaged and moved, for giving a joint absolute rest for even forty-eight hours is sufficient to allow the freshly-broken adhesions time to reunite. Therefore, notwithstanding the pain, every effort should be made to prevent this. It must not be expected that a patient will at once be enabled to move the joint to the extent possible under the anæsthetic, for though there may be no mechanical obstruction, yet from disuse the muscles are atrophied and contracted, thus becoming physically incapable of normal work. To dismiss a patient without correcting this condition is to court almost certain failure; merely telling him to use the joint is for the most part useless, as few people have the strength of will necessary to make their muscles perform their natural functions at the expense of pain. Within a day or so, therefore, the massage may be stopped and the exercises substituted. These, though painful, must be persevered with daily for about twenty minutes, and the increase of strength will bring with it decrease of the pain. This pain, in fact, may be likened to that so often experienced after some unwonted exercise which soon disappears by use and not by rest. The exercises should be continued till the muscles have regained their bulk and the joint its mobility.

FRANK ROMER.

SURGICAL DISEASES OF JOINTS.

INJURIES, internal derangements of joints, and diseases which by common consent are styled "medical," find no place in this article. Thus acute rheumatic arthritis, gout and arthritis deformans are dealt with elsewhere.

The infections to which joints are liable as a sequel to acute epiphysitis will only be considered in so far as they come under the heading of acute suppurative arthritis.

The treatment of epiphysitis belongs to the section on diseases of the bones, and this applies also to new growths involving the joints.

Infective arthritis in the course of acute specific diseases, such as dysentery, influenza, Malta fever and the like, calls for no special consideration in treatment, apart from the treatment of the disease, and the treatment of acute or chronic synovitis.

The diseases of joints of special surgical interest are the chronic blood infections due to the tubercle bacillus and the gonococcus. In so far as the joints themselves are concerned, the surgical field of treatment is covered by an account of the treatment necessary for these diseases.

Syphilitic disease, pneumococcal and typhoid arthritis, arthritis of neuropathic origin (Charcot's disease and syringomyelia), intermittent hydrarthrosis, cysts in connection with joint disease, the affections of joints in hæmophilia, and nervous mimicry of joint disease will be briefly referred to.

The treatment of acute and chronic synovitis and of acute suppurative arthritis will be considered first, to avoid the repetition of methods when considering arthritis under specific titles.

ACUTE SYNOVITIS.

In the treatment of Acute Synovitis, rest, fixation, relief of pain and effusion, the prevention or correction of adhesions and muscular contractions are the main points to be considered.

Rest and Fixation.—Rest and fixation by means of splints and weight-extension will be fully discussed under Tuberculous Disease of the Hip and Knee.

Pain and Effusion.—Pain should be relieved by fomentations and leeches in acute cases, by the actual cautery in the less acute, and by weight-extension whenever possible.

Pressure should be applied to promote absorption of fluid when the more acute symptoms have subsided, by means of a thick layer of wool and an elastic webbing bandage.

This should be followed by massage without movement while the effusion lasts. Passive movements should commence so soon as the effusion has, or has nearly, subsided; adhesions are thereby prevented.

In cases of obstinate effusion it is advisable to aspirate the joint and to re-apply pressure.

Adhesions.—Should adhesions form (except in cases of tuberculous disease), they must be broken down at once by force, which is gradually but firmly applied, not suddenly or violently, while the muscles are relaxed under an anæsthetic.

If it is not possible to employ an anæsthetic, then the necessary movements must be carried out suddenly and unexpectedly when the muscles are off their guard.

The acute pain which follows the sudden snapping of adhesions can often be relieved by creating a rapid superficial hyperæmia, either by plunging the joint into very hot water, or preferably by means of rapid and forcible "slapping" over the surface of the joint.

Deformity.—Deformity is prevented by the proper attention to the relief of inflammation; but when prolonged rest is necessary, muscular contraction often produces very marked deformity, more especially in the case of the hip or knee.

The *rôle* of weight-extension in the prevention or correction of muscular contraction is considered under Tuberculous Disease.

When muscular spasm has been followed by actual shortening, then tenotomies are necessary. When inter-osseous fibrous adhesions prevent correction, traction splints may be used (such as Hoefftcke's) after muscular spasm has been overcome by weight-extension and tendon contraction has been relieved by tenotomy. Severe deformity may require either an osteotomy or excision. (*See* Tuberculous Disease of Joints.)

ACUTE SUPPURATIVE ARTHRITIS.

When pyogenic organisms gain access to a joint they lead to inflammation of all the structures of the joint, followed by suppuration, and ultimately to destruction of the component parts of the joint.

Local Treatment.—The first question to be decided when a joint is involved in acute suppuration is whether an attempt should be made to save the limb.

This will depend on the age and general condition of the patient, the nature of infection, the extent of involvement of the joint, and the associated conditions.

If it is decided to attempt to save the limb, every effort must be made to check suppuration and to prevent absorption. The function of the joint as such must be disregarded; ankylosis must be expected and looked for as the most favourable issue. At the same time precautions should be taken to secure ankylosis in the best possible position for subsequent use. In exceptional cases some range of movement may be preserved.

The joint should be treated like every other acute abscess, and laid open in such a way that pus is never allowed to accumulate or to "pocket." Continuous irrigation should be employed, so that pus as soon as formed is washed away. No half-hearted measures will suffice. In the case of the knee, for example, lateral incisions on either side of the patella must extend along the whole length of the cavity, and counter-incisions may be made behind each condyle; and if necessary for more thorough drainage, the patella should be divided and the joint laid open transversely. Large stiff rubber tubes must be used freely. Continuous irrigation is employed with hot saline, to which may be added sufficient iodine or permanganate of potash to just colour the solution. It is advisable to ring the changes between the various antiseptics, using always *very weak* solutions.

So soon as suppuration begins to subside the cavity should be packed with iodoform or cyanide gauze in such a way that every loculus is filled. At intervals of three or four hours the cavity should be irrigated with peroxide of hydrogen (ten volumes) and then re-packed. Caution is required to avoid iodoform poisoning.

As an alternative to the use of peroxide, the joint cavity may be flushed out with a stream of oxygen gas introduced by means of a sterilised tube and glass nozzle attached to an oxygen cylinder. The oxygen distends the joint capsule and reaches the remote parts of the joint.

If sinuses form, they must be opened freely regardless of their situation.

If continuous irrigation is not feasible, a water-bath (liquor iodi fortis, ʒj ad Oij) [U.S.P. tinct. iodi, ʒij ad Oij] should be used for the same purpose, and in the intervals between the baths hot fomentations should be applied.

Interrupted plaster splints slung to a cradle, with thin metal bands to bridge the intervals, are extremely useful to secure a fixed position for the limb while leaving the joint exposed.

When the condition improves progress is accelerated by the daily application for an hour or so of an elastic bandage, applied above the joint so as to produce passive congestion.

General Treatment.—An immediate culture is made from the infected joint and at the same time a culture from the blood.

Vaccines should be prepared from the resulting culture.

So soon as the organism is identified a corresponding stock serum should be used; for example, if a streptococcus pyogenes is obtained, then in the case of an adult 20 cubic centimètres of a stock anti-streptococcus serum should be injected, and this may be repeated daily so long as there are constitutional symptoms of absorption.

When a vaccine has been prepared from a patient's own culture, inoculations should be commenced, starting with a dose of one million. The injection should be repeated at intervals of about a week, and gradually increased by doubling the dose up to 10 or more millions. The serum can be continued at the same time. If the appropriate serum is not available, horse serum may be substituted in the same dose.

General measures for supporting the patient's strength by stimulants and tonics need not be detailed here.

Amputation.—If in spite of prompt and vigorous local and general treatment there is no improvement in the general condition, then amputation is imperative.

In other cases, though the general condition improves the local condition does not, and it becomes obvious that the limb is a useless member.

In these cases a certain amount of judgment is required as to how long it is advisable to wait before amputating. It is often safer to delay amputation in cases where it is obvious that the limb has to be removed, if there is a reasonable prospect that the general condition of the patient will continue to improve, rather than to run the risk of death from shock following amputation when the general condition is at its worst.

When amputating above the joint it is important to inspect the medulla at the point of section of the bone to ascertain if it is free from infection.

When the hip or shoulder joints are involved and an amputation is decided on, no attempt should be made to close the wound.

When joints that cannot be removed by amputation are involved, such as the sterno-clavicular, the only alternative is to excise the joint.

Spinal anæsthesia may be used for amputating through the lower extremity when a general anæsthetic is considered unsafe.

Continuous saline infusion should always be employed during the operation, and preferably subcutaneously by means of Lane's rubber bags.

CHRONIC SYNOVITIS AND ARTHRITIS.

As already stated, this article is not concerned with injuries to joints, which are responsible for the great majority of cases of chronic synovitis.

The treatment of chronic inflammation of joints in specific infections of a tuberculous, gonococcal, pneumoccocal or syphilitic nature is described later.

Apart from these diseases there are many cases of chronic arthritis of doubtful origin, often of a toxic nature, traceable to some septic focus in the mouth or in some other part of the body, which, even when the cause is ascertained and treated, require local treatment on routine lines.

It is therefore proposed to outline certain lines of treatment which may be adopted as occasion serves for the management of chronic arthritis after the cause has been ascertained and treated.

The treatment of effusion in acute and sub-acute conditions has already been discussed. These measures apply to cases which are from the first of a chronic nature, but if unsuccessful require to be supplemented by other forms of treatment.

Arthrotomy.—An explanation of the obstinate resistance to treatment in some cases is often apparent when the joint is opened. Hypertrophied fringes, the result of chronic inflammation, often exist and act as foreign bodies. It is essential to remove these to effect a cure.

It is probable that many cases of incurable osteo-arthritis result from a neglect to recognise and to treat this condition of "villous arthritis" in the early stages.

If the chronic irritation produced by these fringes when they interfere with articular movements is allowed to continue, the classical changes in the cartilages and bones associated with the name of osteo-arthritis will result in many instances.

It will often be a matter of extreme difficulty to decide how far to proceed surgically in such cases, especially when the fringes are numerous and more than one joint is involved. No rules can be laid down beyond enunciating the principle that fringes which are liable to be nipped are a menace to the welfare of the joint, and should, whenever possible, be removed.

Hydro-therapeutics.—Treatment under this heading belongs to the province of the physician, and is dealt with in the Special

Article on Hydrology. A brief reference to the subject, however, will not be out of place here.

Hot douching, if arranged so that the pressure can be regulated often, has a very sedative effect on the nerve endings, and by its anodyne action permits of movements otherwise impossible. The combination of douching, massage and movement, known as the Aix-les-Bains massage douche, is deservedly popular. Tissue change is stimulated by artificial pyrexia produced by hot bathing, and the skin is encouraged to act. At the same time a liberal ingestion of mineral waters increases elimination of waste products in the urine.

The benefit to be derived from natural thermal baths at the various English and Continental spas will not be discussed here.

Electro-therapeutics.—*Cataphoresis.*—In recent years treatment by galvanic ionisation has been extensively used, and with considerable success, to promote the absorption of fibrous tissue. Considerable difference of opinion exists as to the ions most useful for this purpose. Salicylates, iodine, lithium, chlorine may all be used for the purpose. Probably the best method is to use lithium and iodine together, the former at the positive, the latter at the negative pole. Two pads are used for electrodes, and applied one on either side of the joint. An average current of 25 milliampères is employed for about half-an-hour at a time and repeated daily.

Metals and alkaloids, when employed, must be applied at the positive pole. Iodine and salicylic acid are electro-negative, and must be applied at the negative pole.

High-frequency and static wave currents are useful accessories in producing hyperæmia, and in this way relieve pain and stimulate metabolism.

The wave current is especially useful for restoring movement when tendons are adherent in the neighbourhood of a joint. The method is painless, and individual tendons can be picked out with minute accuracy. It is often used in combination with radiant heat. The following is a description of this form of treatment by Dr. Eliot Creasy.[1]

"The 500 candle-power incandescent lamp is peculiar in the character of the reflection; instead of a parabolic reflector with one focal point, there is a corrugated reflector and conical side reflectors, which project lines in parallel and crossing lines of radiation having two parallel fields of greatest brilliancy and intensity. This arrangement permits the operator to move the lamp about in such a manner that these two fairly large fields of intense radiation can be tolerated as they cannot be when detained in one position directly over the regions of tenderness or inflammatory involvement. At the same time the whole surface receives a liberal radiation of light and heat. The effects upon simple inflammation, unaccompanied by infection, are to induce general tissue relaxation with relief of pressure and pain; by increasing local metabolism and elimination to relieve the tissues of the irritating products of defective metabolism present in conditions associated with myalgias and similar conditions; and in conditions of mild traumatic injury, treated properly after injury, to remove early stasis.

"The electric wave current may be classed as an agent which is capable of increasing the physiological resisting power of the part to which it is applied. It restores the metabolic equilibrium which is disturbed in all conditions characterised by increased venous and decreased arterial pressure. Passive congestions are removed by improving the physiological 'tone' of the affected region. Pain is relieved because nutrition is rectified and toxic material turned into the proper excretory channels. Health has been defined as a condition characterised by perfect equilibrium of arterial and venous blood pressure. Disturbance of this equilibrium results in locally increased arterial pressure or locally augmented venous pressure, both conditions resulting in disturbed nutrition of the nerves, whose cry for proper nutriment is called pain. The wave current, in restoring the physiological tone of the affected area, tends to re-establish the normal equipoise of the two forms of pressure, and in this way counteracts stasis and relieves pain."

Electrical water baths are often very serviceable for the relief of pain and to improve the nutrition of wasted muscles. Either the Schnee four-cell bath or the hydro-electric bath may be used.

In the former the faradic, galvanic or sinusoidal currents are used, and each limb to be treated is immersed in a porcelain cell. In the latter the whole body is immersed in a porcelain bath, and the currents are passed from one end to the other by means of copper electrodes.

The sinusoidal current in the Schnee bath is probably the most useful form of electric bath for chronic arthritis.

Electrical hot-air baths (Active Hyperæmia).—Either the Dowsing radiant-heat or the Greville non-luminous bath may be used.

In the Dowsing bath radiant heat is obtained by means of special electric lamps fitted in burnished reflectors. The heat rays are directed on to the joint in a closed apparatus, and temperatures from 200° to 300° F. may be used.

In the Greville bath the heat is obtained through naked wires, and the non-luminous rays beyond the red alone are used.

Both forms are decidedly useful, and especially the former, to restore tone to the muscles, stimulate metabolism, and increase mobility.

Passive Congestion (*see* p. 751 and Bier's method, Vol. III.).

Fibrolysin.—This substance, which is a combination of thyosinamin and salicylate of soda, possesses the power in some cases of absorbing fibrous tissue. When used in conjunction with other forms of treatment, such as hot douching, massage and extension, it is often beneficial. Used alone, in the writer's experience, results have been disappointing.

Merck's preparation should be used, which consists of an aqueous solution of 15 per cent. strength put up in glass ampullæ, each containing 2·3 cubic centimètres.

It should be injected into the gluteal muscles. When given under the skin, pain and swelling often result. Injections may be given once or twice a week and continued at regular intervals.

In some cases there is a marked reaction, with rise of temperature and even rigors. A smaller dose should be tried, and if a similar reaction follows, the treatment should be abandoned.

Counter-irritation and Local Applications.—Blisters applied over the surface of the joint or along the line of the nerve trunk involved are very valuable for the relief of pain. Dr. P. W. Latham and Dr. Midelton, of Bournemouth, are advocates of blisters applied on either side of the spinal column, over the cervical enlargement for the upper extremity, and the lumbar for the lower. Repeated applications are necessary, and the surfaces should be dressed with savin ointment. These are especially valuable in chronic rheumatoid arthritis (*see* Special Article, p. 405).

Next to blistering there is nothing so successful as the actual cautery.

Hot sand-bags at night will often relieve pain and induce sleep when nothing short of narcotics will succeed.

The most useful liniments are those of iodine, of methyl salicylate, opium and menthol, aconite, chloroform and belladonna, and the oleate of mercury (10 per cent.), to which may be added hydrochloride of morphia (½ gr. to ʒj of the oleate).

INTERMITTENT HYDRARTHROSIS.

The above condition may be defined as a recurrence of effusion into one or more joints, at regular or irregular intervals, without any permanent lesions resulting.

These effusions may occur into joints which are apparently normal or into joints previously damaged by disease or injury.

Treatment.—It is difficult to discuss the treatment without entering more fully into the etiology of the condition, but the following are the methods of treatment which have been most successful.

General.—Arsenic, in the form of Fowler's solution in increasing doses and continued for long periods, is the most useful of all drugs. Quinine and aspirin are sometimes beneficial.

Local.—The rhythmic sinusoidal current in Schnee's four-cell bath should be used during the attacks. Hot-air and radiant-heat baths are also useful. Rest is essential during the attacks.

BURSÆ AND CYSTS IN ASSOCIATION WITH ARTHRITIS.

Bursæ, which sometimes communicate with joint cavities, often become distended when effusion takes place into the joint, *e.g.*, the semi-membranosus and ilio-psoas bursæ. The importance of these cases lies in the fact that the joint disease may be overlooked in treating the bursal lesion as if it were an uncomplicated case of bursitis.

Treatment consists in cutting down on enlarged bursæ, and if possible dissecting them out, when they are not associated with disease of the joint. Should they occur in association with tuberculous disease it is not advisable to operate on them unless the condition of the joint calls for operation. If they occur in connection with osteo-arthritis and give rise to symptoms, they should be removed. Not infrequently they are enlarged in syphilitic disease, and should be treated accordingly.

Enlarged bursæ in the neighbourhood of joints, but not in communication with their cavities, are sometimes tuberculous, and require to be carefully dissected out. This is especially the case with the bursa surrounding the tendons of the sartorius, gracilis and semi-tendinosus.

In operating on an enlarged psoas bursa attention must be paid to its relationship to the femoral vessels and the anterior crural nerve. The femoral vessels are pushed forwards and a little inwards in front of the bursa, and the anterior crural nerve is stretched over the surface and to the outer side. The bursa usually communicates with the joint cavity, and in its situation closely resembles the sac of an obturator hernia.

Cysts.—Considerable interest attaches to the adventitious cysts which sometimes form in connection with tuberculous disease of joints and occasionally in osteo-arthritis and Charcot's disease. A remarkable feature of these cysts is the remote connection which they often appear to have with the joint from which they originate.

When a large inter-muscular cyst appears in the arm well below the shoulder-joint, in the forearm remote from the elbow, or in the calf or thigh at some distance from the knee, the neighbouring joint must be carefully examined for evidence of disease.

The strictest asepsis is required in operating on these cysts, especially when drainage is adopted, to guard against secondary infection. As already stated, they are usually tuberculous in their origin, and require to be treated, together with the joint involved, on the lines laid down for tuberculous disease.

It is important to note that they occur most often in patients who have passed middle life, when repair from tuberculous joint disease is little likely to take place.

TUBERCULOUS DISEASE OF JOINTS.

The General Treatment of a tuberculous patient, apart from the treatment of the joints, will not be discussed here (*see* p. 1127). In considering the treatment of tuberculosis of joints it will be assumed that the best hygienic surroundings, open air, good food, cod-liver oil, etc., are recommended.

To realise the benefits which follow the treatment of tuberculous joints in a country hospital, under a system which enables the majority of the patients to spend most of the day in the open air, it is necessary to visit one of the country homes, such as the Cripples' Home at Alton, which has been founded by Sir William Treloar. All stages of tuberculous joint disease are treated there, and to a great extent in the open air; specially made boxes, which are easily carried about, are used for the patients to lie in. These can be mounted on wheels, and so arranged that any position from the vertical to the horizontal can be adopted (Fig. 1).

Tuberculin and other Vaccines.—The value of tuberculin as an *adjunct* to open air, good food, and rest has now been definitely established in tuberculous joint disease. The ideal time at which to start injections is at the commencement of the disease. After removal of diseased tissues by operation, the injections may be used to prevent recurrence.

If marked fever exists, the vaccine should be withheld. In cases of suppuration and sinus formation, if a mixed infection has occurred, the tuberculin should be combined with a vaccine made from the infecting micro-organism. The new tuberculin (T.R.) is used, and the dosage varies with the age of the patient and the severity of the infection.

For an adult it is advisable to commence with a dose of $\frac{1}{10,000}$ of a millegramme, injected subcutaneously. The injection should be given every ten days, and gradually increased up to $\frac{1}{1000}$ millegramme in a period of three months. After this period the latter dose may be continued for a further period of three to six months. For children under ten the dose should be half that for an dult.

It is not necessary to take records of the opsonic index; the best control is the clinical condition. Koch's old tuberculin is now

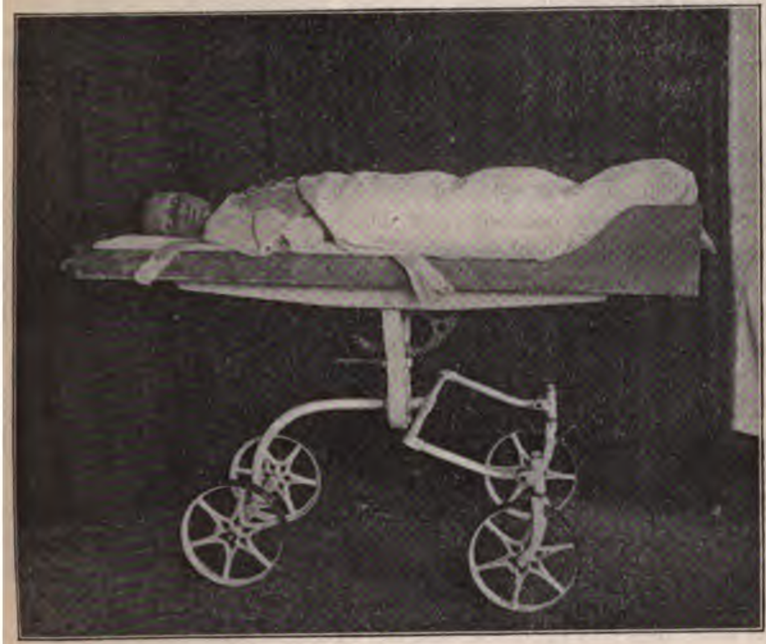


FIG. 1.—Portable stand for use with spinal board (Gauvain's). The patient is fixed absolutely in any position required and can be placed in a horizontal or vertical plane with the greatest ease. A modification of this contrivance is in use, on which the patient can be placed in any position, in any plane—face downwards if necessary—and is of particular value in the drainage of abscesses. (Manufactured by Messrs. Maw, Son & Sons, Aldersgate Street, E.C.)

chiefly used for diagnostic purposes (*see* Tuberculin Therapy, Vol. III.).

Passive Congestion.—In cases of tuberculous synovitis with effusion, especially of the knee, ankle, elbow, and wrist, considerable benefit often follows the application of a constricting bandage above the joint, if judiciously applied. It must be applied in such a way as not to constrict the arteries, but only to modify the return of venous blood.

If pain is produced, then the bandage must be loosened. The limb below the bandage becomes congested, but should not be allowed to become either pallid or mottled.

The bandage should be applied for about an hour a day to commence with, and then for increasing periods up to about six hours at a time each day. Gentle massage to the limb below the joint should follow removal of the bandage.

Rest in a good position is the most important item in the treatment of a tuberculous joint.

This is secured either by splints of leather, plaster or some other substance (*see* under Individual Joints), recumbency, and weight-extension.

At the same time *deformity* consequent on muscular contraction must be prevented.

Operative Treatment consists in the injection of substances such as iodoform emulsion or bismuth paste into the diseased joints, the evacuation of caseous pus, the dissection and removal of diseased synovial membrane (erasion), re-section of the joint surfaces (excision), amputation, and for deformity, tenotomies, plastic operations or osteotomies.

These methods will be dealt with under Individual Joints.

The Test of a Cure.—It is very important to know when tuberculous disease has been arrested in a joint which is undergoing treatment by rest and fixation.

When pain and muscular spasm have been abolished and swelling has subsided, the splint may be removed as a temporary measure. If the disease is still active, muscular spasm will return, *i.e.*, the range of mobility will diminish.

If ankylosis has occurred and the splint is removed, a change in the angle of fixation, accompanied by pain on use of the limb, will result if disease is still present.

TUBERCULOUS DISEASE OF THE HIP-JOINT.

Tuberculous Synovitis.—If the synovial membrane of the hip becomes inflamed, *rest*, combined with *weight-extension* to overcome muscular spasm, is essential to rapid recovery. Muscular spasm is a natural response to inflammation within the joint; inflammation demands immobility, the muscles respond by fixing the joint. Unfortunately muscular spasm produces inter-osseous pressure; inter-osseous pressure results in friction between inflamed surfaces and produces pain.

Weight-extension.—Weight-extension correctly applied gradually overcomes muscular spasm, relieves intra-articular pressure, keeps the inflamed area at rest, and so alleviates pain and at the same time prevents deformity, an inevitable sequel to long-continued muscular spasm.

Weight-extension incorrectly applied produces leverage. The joint becomes a fulcrum. Leverage at the joint produces intra-articular pressure.

Inter-osseous pressure when the opposing surfaces are inflamed causes pain. Consequently weight-extension must be applied in *the line of deformity* (Fig. 2), so that counter-extension comes into play in a line with extension.

When the hip-joint becomes inflamed, the thigh becomes flexed by the contraction of the psoas and iliacus, and at the same time slightly abducted and rotated outwards (the position of greatest ease, *i.e.*, of relaxation of the anterior portion of the capsule of the hip-joint). If the leg is pulled upon until the thigh becomes horizontal, the pelvis, owing to the contraction of the psoas muscle, is rotated on a transverse axis, so as to produce a forward curvature of the lumbar spine (lordosis, Fig. 3 *a* and *b*). Force thus applied is by leverage of the second order, and produces not relaxation of contracted muscles, but inter-osseous pressure. If the weight is applied as in Fig. 2 it is clear that extension and counter-extension come into play, and that the result is gradual relaxation of the contracted muscles and relief of inter-osseous pressure.

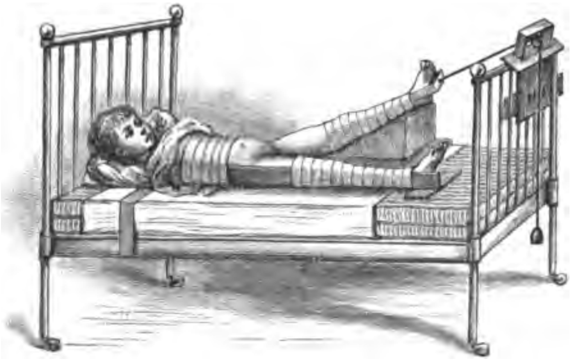


FIG. 2.—Method of using extension when the limb is merely flexed on the trunk. (Marsh & Watson's Diseases of Joints, Cassell.)

The extension apparatus consists of a thin square of wood, to which is fixed a stirrup of adhesive strapping, made to extend from a few inches below the heel to well above the knee. If the extension is not carried above the knee, the extension acts on the knee-joint as well as on the hip, and after a time produces relaxation of the capsule of the knee-joint. The extension is firmly bandaged to the leg and thigh, and the weight applied by means of a cord, which runs from the centre of the wooden block over a pulley (fixed in the line of deformity). The malleoli must be carefully protected from pressure. A tin-can is attached to the free end of the cord and filled with ordinary gun-shot, according to the amount of weight required. When the extension is first applied, very little weight is attached for fear of the extension yielding before it has become firmly fixed. The weight is then gradually increased. The amount of weight required varies considerably with circumstances. Speaking generally, weight at the rate of ½ lb. for each year of age up to twenty years is sufficient for most purposes; but often, when considerable deformity requires correction, double the amount may be used, provided that the amount is gradually increased and the extension is firmly applied.

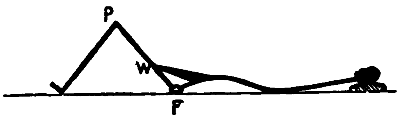


FIG. 3*a*.—Posture of the limb in hip disease in which Weight extension acts by leverage. (Marsh & Watson's Diseases of Joints, Cassell.)

If no deformity exists, and if weight-extension is applied as a prophylactic to prevent contraction and to guard against pain, quite a small weight is in most cases sufficient (5 or 6 lb. in an adult).

For small children, especially if they are inclined to be restless, it is often advisable to apply a long Liston splint to the sound side. The weight must be kept on at night as well as in the daytime. The thigh, when considerably flexed, is supported by an inclined-plane splint (Fig. 2); if slightly flexed, a firm pillow will suffice. As the muscles relax, the position of the thigh is gradually lowered.

To ascertain if the thigh can be lowered, one hand is placed behind the lumbar spine, and the thigh is then gradually lowered. Directly elevation of the lumbar spine occurs, re-position of the thigh is indicated. The limb must be allowed to remain at that level which just avoids lordosis. It is surprising to see with what rapidity muscular contraction can be overcome in this way. A thigh flexed nearly to a right angle by muscular contraction alone can often be reduced to full extension in about three weeks.

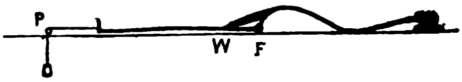


FIG. 3*b*.—Weight extension acting by leverage.

If rest and weight-extension are made use of early in an attack of synovitis, pain will be a negligible quantity, and no appreciable effusion is likely to occur into the joint cavity. If effusion is extensive (a rare occurrence in the hip), the joint should be *aspirated* from the front. The joint capsule is exposed by a short incision made parallel to the femoral vessels, and commencing immediately below the anterior superior space of the ilium. By dissection the interval between the rectus femoris and sartorius on the inside and the gluteus medius and minimus on the outside is exposed, and the surface of the capsule is then seen and may be aspirated by means of a trocar and cannula or with a scalpel.

Aspiration is seldom required for a simple effusion into the joint; but, if required, should not be attempted without an open incision.

In obstinate cases of effusion, blisters should first be tried; if these are ineffective, then the actual cautery should be used. The cautery at white heat is applied to the anterior surface of the joint, and from ten to twenty small spots lightly touched.

Rest and Fixation—In the early stages of tuberculous disease of the hip, absolute rest, fixation of the joint in good position, fresh air, and good food are essential to rapid recovery. In the well-to-do and with those who can afford good food and fresh air, a successful issue is the rule if treatment is continued for a long enough period. There are difficulties to contend with both from patients and friends. On the one hand a period of complete inaction—it may be a year or more—is extremely irksome, especially if the general health is good and pain a negligible quantity; and on the other there is a popular idea that prolonged rest means a stiff joint and impairment of general health. There is no greater fallacy. Inflammation produces first granulation tissue, then fibrous tissue and fixation, and the one thing needful to check inflammation is rest.

It may indeed happen that in spite of rest the inflammation may go on to the formation of granulation tissue, erosion of cartilage, destruction of bone, and ultimately to adhesions and ankylosis. Here and there a case will take this course despite all treatment, and would do so far more rapidly were rest withheld. Amongst the poor results will necessarily not be so good unless the patients can be admitted to hospital.

In the case of children, rest on the back with weight-extension should be insisted on from the first, and should be continued until pain, limitation of movement and deformity have been abolished, and it is advisable as a precautionary measure to continue this treatment for three months or so after the subsidence of all symptoms. Not infrequently it will happen that when rest and fixation are commenced early in the course of the disease, pain and limitation of movement will rapidly vanish; but if the weight is removed and the child is allowed to move about, these symptoms will return.

In many instances treatment on these lines may have to be continued for as long as two years to effect a cure, and in the great majority of cases a cure will result if rest and fixation are persevered with.

No ill-effects follow prolonged rest in bed, provided that deformity of posture is prevented. In the Alexandra Hospital for Hip Disease the most healthy looking children are usually those who have been longest in bed (if suppurating cases are excluded).

When all active disease has subsided, *i.e.*, when all symptoms have disappeared, and after a further period of precautionary rest has been carried out, the child should be allowed to walk on crutches, with the affected hip fixed in a Thomas's hip splint (*see* Fig. 4). In order that no weight should be borne on the affected hip, a patten is worn on the boot of the sound leg. At the same time daily massage should be employed to the wasted muscles of the buttock, thigh and calf. No fixed rule can be laid down as to the length of time required before the splint can be discarded; so much will depend on the severity and duration of the attack and the stage at which treatment was commenced. In most cases it will not be advisable to discard the splint until at least three months have elapsed after the subsidence of all symptoms.

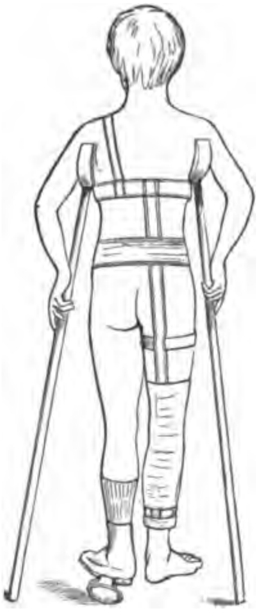


FIG. 4.—Thomas Hip Splint. (Marsh & Watson's Diseases of Joints, Cassell.)

Primary Bone Disease.—Hitherto it has been assumed that we have been dealing with a child attacked with tuberculous synovitis. Should tuberculous disease commence in the bone, and should the disease first make its appearance in adult life or in old age, certain modifications in treatment are required.

In the first place, in all cases a radiogram should be taken of the joint.

Should it appear that the disease is situated at the epiphysial line, it may be advisable to expose the joint, open the capsule and scrape away the diseased tissue, and by this procedure it may be possible to prevent invasion of the joint and a secondary infection of the synovial membrane with tuberculosis. In the case of the hip the disease commences in the synovial membrane somewhat more frequently than in the bone, and the articular surfaces are secondarily affected.

Tuberculous disease commencing in adult life or in elderly people responds less readily to treatment by rest, and is more prone to advance to caseation and suppuration. Operative measures are therefore indicated at an earlier stage.

Abscess.—When caseation occurs and a tuberculous abscess forms in the hip-joint, an expectant line of treatment should be adopted in the first instance. If absolute rest is maintained, spontaneous absorption may occur.

If the abscess shows signs of increasing it should be aspirated, and the caseous material evacuated under the strictest aseptic precautions. The greatest care is required to avoid a tuberculous infection of the aspiration track and the subsequent formation of a sinus, with the added risk of a secondary staphylococcal infection from the skin. A long trocar should be used, and this should be passed through the tissues superficial to the abscess in such a way as to render the track oblique and valvular. When the pus has ceased to flow a syringe should be attached and the cavity emptied. Suction should be kept up with the syringe as the trocar is withdrawn to prevent any pus which may remain in the cannula infecting the line of puncture.

It may be necessary to re-aspirate the cavity on several occasions, and in most cases a successful result will follow.

Should the pus be so thick that it will not flow through the cannula, a method may be adopted which is recommended by Gauvain, who has had considerable experience with it at the Cripples' Home at Alton.

From 2 to 3 cubic centimètres of a solution containing 1 part of camphor, 2 of thymol and 3 of sulphuric ether is injected into the cavity, and allowed to remain from twenty-four to forty-eight hours. At the end of this time aspiration is again performed, and the pus will then be found to be considerably modified. The caseous material is liquefied, reddish brown in colour, and smells strongly of camphor. Not more than 5 cubic centimètres of this fluid should be injected, as in a few instances toxic symptoms have occurred.

If in spite of repeated aspiration the pus re-collects and the abscess cavity does not show signs of getting smaller, from 5 to 10 cubic centimètres of a solution of iodoform in ether (10 per cent.) may be injected (Gauvain).

This solution has a sclerosing effect on the walls of the cavity. The ether volatilises and the iodoform is precipitated on to the walls of the cavity. Certain precautions must be observed. The fluid must be injected slowly and the piston of the syringe not withdrawn until as the ether begins to evaporate it is gradually pushed out. The volatile ether is then allowed to escape through the syringe. In this way the liquid ether is prevented from escaping before it has volatilised and precipitated the iodoform, and at the same time the volatile ether is withdrawn. If the ether is allowed to remain it causes considerable distension and irritation of the cavity.

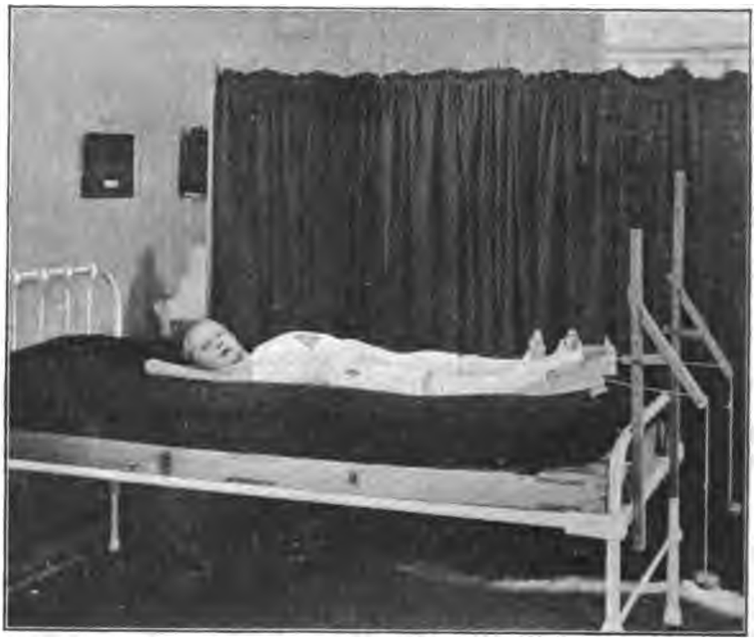


FIG. 5.—Patient suffering from a tuberculous disease of both hip-joints. Deformity has been corrected; the hip-joints are immobilised, and simultaneously extension is abolishing muscular spasm. An abscess which was present has become absorbed. Its evolution or absorption may be observed through the window shown in the illustration. (Gauvain.)

Occasionally toxic effects are produced by the iodoform, so that it is not advisable to inject more than 5 cubic centimètres in the first instance. Iodoform and ether should not be used when the pus is thick and caseous, as the caseous material may prevent the exit of the ether.

In the most obstinate cases Gauvain uses a solution of iodoform (5 grammes), ether (10 grammes), guaiacol and creosote (2 grammes each) in 100 cubic centimètres of sterilised olive oil.

Sinus Formation.—If a sinus has formed it will be necessary to open up the abscess and irrigate out the cavity with saline solution. Irritating antiseptics should be avoided, and scraping away the protective wall may result in a general tuberculous infection, so that the less the cavity is disturbed the better. Sequestra may sometimes be found and removed, and very often after the removal of a sequestrum healing occurs.

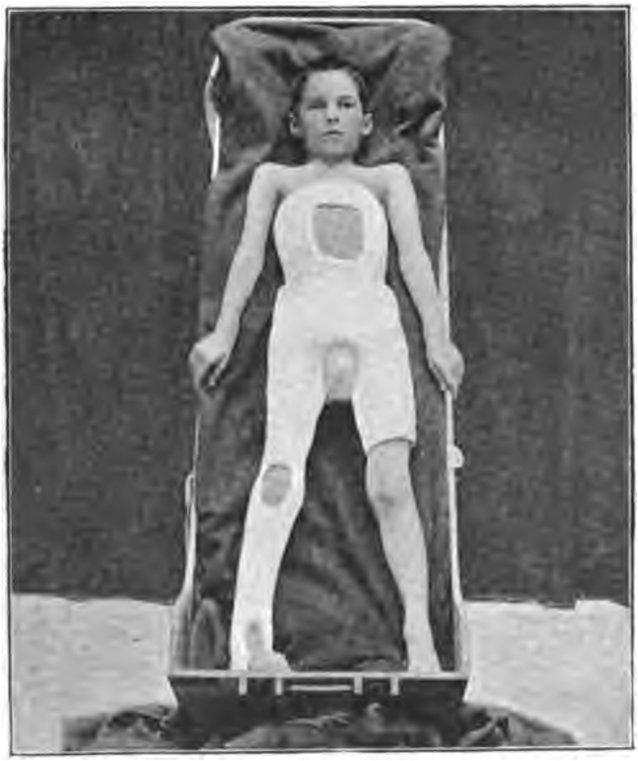


FIG. 6.—Patient suffering from tuberculous disease of the right hip and knee-joint immobilised in plaster of Paris. The deformity has been corrected. (Gauvain.)

The wound should be closed and firm pressure applied.

If a mixed infection has already occurred drainage is necessary, and a more radical treatment of the cavity by gentle scraping and irrigation with a weak iodine solution is advisable. Vaccines should be prepared from the contaminating organism and used as soon as possible.

In cases of chronic sinus formation the injection of bismuth paste may be tried (bismuth, 6 parts; white wax, 1 part; soft paraffin 12 parts). It should be injected slowly while hot, and allowed to remain in the sinus as long as possible.

Plaster—A well-fitting plaster of Paris splint, combined with weight-extension in the early stages and as a substitute for Thomas's splint in the later stages, provides most admirabl fixation, and can be used also for cases complicated with suppuration if windows are cut.

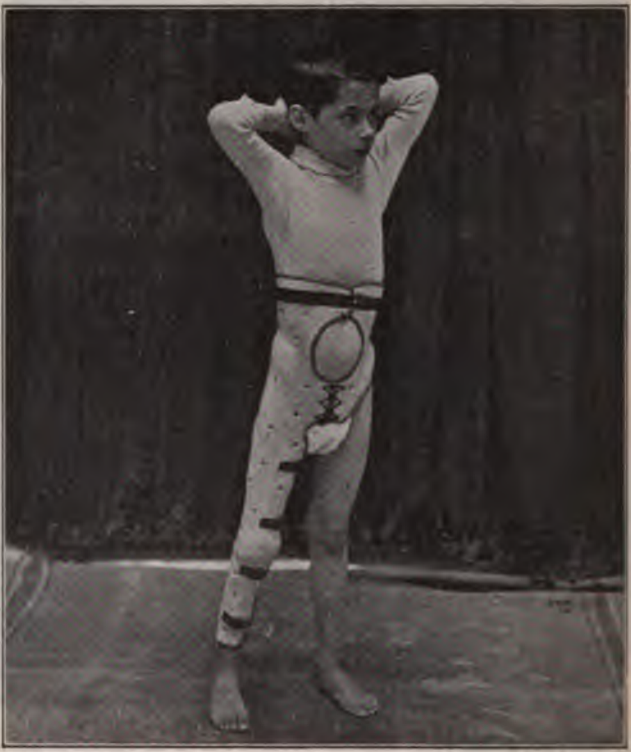


FIG. 7.—A stage further in the treatment of hip disease. The same patient with a celluloid hip- and knee- splint. (Gauvain.)

Considerable practice is required to successfully immobilise th hip without producing undue pressure, and to make a really goo plaster splint which is not too heavy and yet will not crack, and good deal of time is expended in the process. Fig. 5 illustrates the method as employed by Gauvain at Alton.

He uses plaster in the early stages. Under an anæsthetic muscular relaxation is secured, and the hip then immobilised in the best possible position, weight-extension being employed at the same time. Weight-extension is first put on in plaster and made to extend above the knee, and then the hip-joint is fixed by an independent plaster.

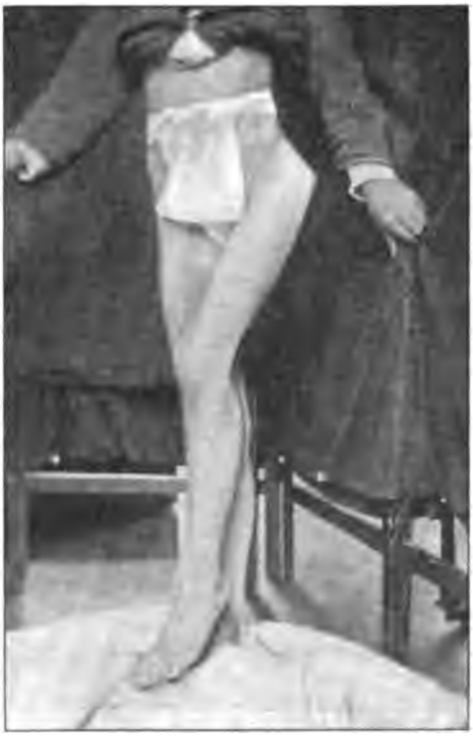


FIG. 8.—Ankylosis with flexion and adduction after tuberculous disease of the hip.

When spasm has been finally abolished, a single plaster is employed extending from the nipple to the toes (Fig. 6). Later on a celluloid splint may be substituted for the plaster splint (Fig. 7). Care is taken to avoid adduction, flexion and eversion by over-correction, *i.e.*, by fixation in slight hyper-extension, abduction and inversion. Gauvain secures inversion by an ingenious method of elastic traction. One elastic bandage is rolled once round the leg plaster from without inwards and fixed to the outer side of the bed, the other is also rolled from without inwards and fixed to the inside of the bed. Both bandages are first fixed to the plaster splint: the former leaves the leg at the lower surface, the latter at the upper.

Deformity and Ankylosis.—As already stated, the deformity resulting from muscular spasm is easily corrected in the early stages by weight-extension. In long-standing cases deformity is the result not only of muscular contraction, but also of ligamentous contraction, and may be due also to absorption of bone and upward displacement of the limb, with or without ankylosis. If the hip becomes fixed in old-standing cases in the position of flexion, or adduction, or flexion with adduction, the deformity should be corrected by sub-trochanteric osteotomy, combined with tenotomy of the contracted adductor tendons and surrounding fascia. If the deformity is severe and uncorrected it becomes a serious obstacle to walking, because of the necessary lordosis and lateral tilting of the pelvis required to bring the deformed leg into a position parallel with the sound side (Figs. 8 and 9).

In correcting severe adduction deformity it is advisable to somewhat over-correct, *i.e.*, the limb after operation should be fixed in the abducted position.

In this way the actual shortening is partly compensated for by the downward tilting of the pelvis on the diseased side (Figs. 10 and 11). After osteotomy the limb should be put up with a long Liston splint, interrupted at the level of the osteotomy, so that the splint may be bent to the necessary angle. Weight-extension should be applied at first, as in the case of fracture of the femur, to prevent unnecessary shortening and to relieve pain. In an adult at least six weeks are required for firm union.

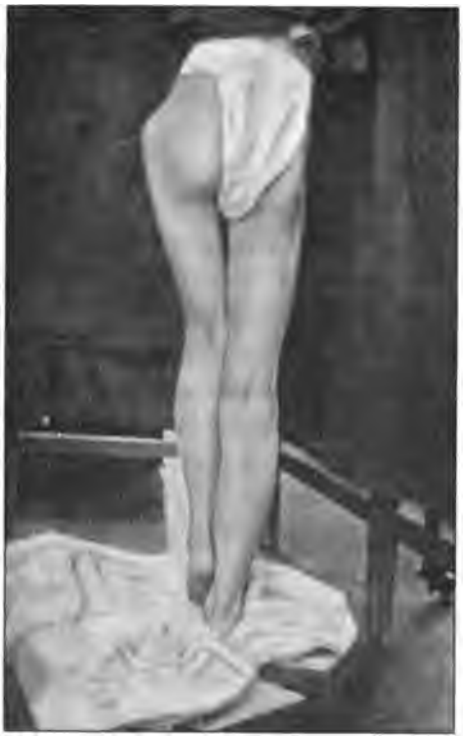


FIG. 9.—Ankylosis with flexion and adduction after tuberculous disease of the hip. The pelvis is tilted to increase the adduction.

No osteotomy should be performed as long as any signs or symptoms of active disease are present, and when fibrous ankylosis has resulted it is advisable to wait until fixation is complete and the joint practically immobile.

Division of the neck of the femur to correct deformity resulting from ankylosis requires a more extensive operation, is more difficult, and produces no better results than a sub-trochanteric osteotomy, which is practically a subcutaneous operation. If this operation is decided on, the neck should be divided as close to the great trochanter as possible.

In many cases there is little or no neck of the femur to divide. As an alternative to complete transverse sub-trochanteric osteotomy, a wedge may be removed without completely dividing the shaft, so that the inner border of the shaft is left intact. The fracture may be completed with the hands in a week or ten days when the skin wound has healed.

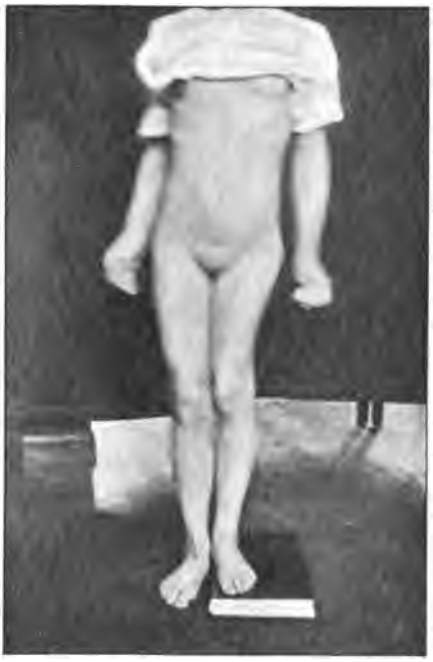


FIG. 10.—Ankylosis at the hip joint. Flexion and adduction corrected by sub-trochanteric osteotomy. Photograph of the patient shown in Fig. 7 taken one year after correction of the deformity.

Acute Suppuration (Secondary Infection). — If acute suppuration occurs in the hip-joint, the joint cavity must be exposed, the pus evacuated and the joint irrigated with a normal saline solution and free drainage provided. A culture should be made from the pus and a vaccine prepared. Further treatment will depend on the degree of severity of the infection, and on the general condition of the patient. If at the time of operation the infection is confined to the hip-joint, and if the joint is not already disorganised, daily irrigation with weak antiseptics, such as perchloride of mercury (1 in 6,000), should suffice to check the disease. If suppuration continues, vaccines should be employed, and the joint washed out with peroxide of hydrogen (10 volumes). If the condition becomes chronic the antiseptic used for irrigation should be constantly changed. Iodine baths twice daily for about half an hour are often of great value (liquor iodi fortis ʒj [U.S.P. tinct. iodi ʒij] to 1 gallon of hot water).

The joint may once or twice daily be distended with oxygen by means of a sterilised glass nozzle attached to the rubber link on the cylinder.

If destruction of bone has occurred and the joint is disorganised, all diseased bone should be scraped away and the joint cavity packed with iodoform gauze.

Continuous irrigation may be employed in acute cases by means of a douche-tin suspended above the bed. A Playfair's rubber drainage-bag is placed under the buttock, and the fluid allowed to drain away into a receptacle beneath the bed. Care must be taken to avoid unnecessary chill by means of a well-blanketted cradle, and if necessary hot-water bottles.

Weight-extension, as described above, should always be employed, and great care taken to prevent deformity of posture in cases of long-continued suppuration. The usual sequel to recovery from acute suppuration in the hip-joint, unless the disease is cut short in the early stages, is ankylosis, and frequently firm bony ankylosis.

If the limb is left uncontrolled the thigh will become flexed, adducted and inverted, and fixed in this position (see Fig. 8). In some cases, owing to the destruction of the head of the femur, marked shortening is combined with the adduction; in others a dorsal dislocation occurs.

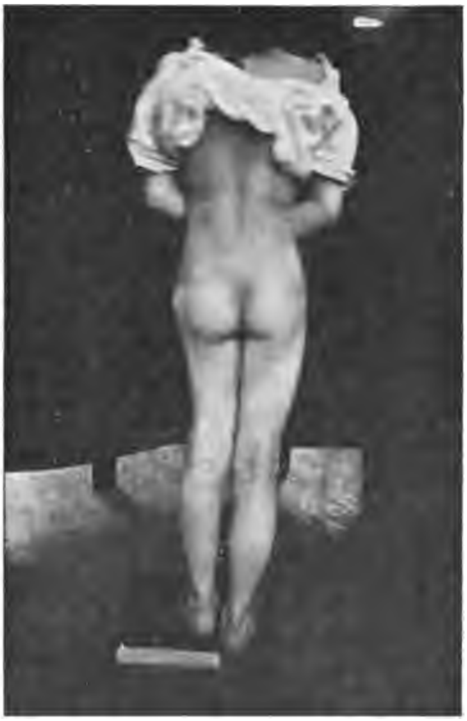


FIG. 11.—Ankylosis at the hip joint. Flexion and adduction corrected by sub-trochanteric osteotomy.

If the component parts of the joint are destroyed, ankylosis is inevitable; but ankylosis in a faulty position is preventable by weight-extension, and is a reproach to surgery should it be allowed to occur.

Ankylosis in a faulty position should be corrected by sub-trochanteric osteotomy, and if real shortening remains after correction, as is often the case when the head of the bone has been destroyed, then the shortening may be compensated by means of a thick sole to the boot.

If a pathological dislocation occurs without destruction of the head of the bone, it should be reduced at once and weight-extension applied in the abducted position. Should the head be destroyed and the acetabular cavity deformed, considerable difficulty may be experienced in keeping the limb in position, but an attempt must be made to secure ankylosis in the best possible position.

If the dislocation is of some standing and the head not destroyed, it may be possible to restore or partially restore the normal position by resecting the head of the femur from behind, and breaking down adhesions by manipulations.

It will often be necessary to perform extensive tenotomy of the adductor tendons and contracted bands of fascia in the adductor region before commencing manipulation.

Prolonged Suppuration.—When suppuration has continued for a long time uncontrolled by drainage, irrigation, vaccines and other appropriate treatment, the patient is in danger of death from amyloid disease. In these cases amputation at the hip-joint should be performed. It is of the utmost importance to avoid loss of blood in such cases, and it is advisable to control hæmorrhage by pressure on the common iliac artery, which can be felt and controlled in an emaciated child through the abdominal wall.

Traction Splints.—Many ingenious splints have been devised, especially by American surgeons, for combining traction with fixation and for use with crutches. Many of these are expensive, complicated, require constant attention, and cannot be recommended for hospital use in preference to the simple and inexpensive Thomas's splint.

When deformity has been corrected traction is not essential to successful treatment, and a Thomas's splint can be used so as to check or diminish flexion and adduction or abduction.

Thomas's Hip Splint.—The splint should be made of the softest and toughest iron, so that it can be bent to meet requirements and is free from elasticity. Both body and leg portion should be straight and parallel, and the only curve in the splint should be a bend at the buttock. When required an adduction or abduction wing can be added to the splint. This wing takes its purchase midway between the crest of the ilium and the ribs, on the opposite side to the disease for adduction and on the same for abduction.

TUBERCULOUS DISEASE OF THE KNEE-JOINT.

Rest and Fixation.—The best method of fixing a tuberculous knee before deformity has occurred is with a leather splint, made of undressed leather, soaked in hot water or water and vinegar. When thoroughly soft this should be moulded to the limb by means of a bandage, and left on for some hours until the leather has hardened to the shape of the limb.

It should extend well below the calf and as high as possible up the thigh, and should be made in two halves, connected by webbing straps and lined with wash-leather (Fig. 12). The splint is further improved by a thin iron rod on either side, which fits into the heel of the boot and so prevents the splint slipping down, which it is prone to do when the limb is wasted and the patient is allowed up. Failing this, a poroplastic splint or a Croft's plaster splint will serve.

Needless to say, in the early stages, and when the disease is active, no weight should be borne on the diseased limb. If there is any rise of temperature, much pain or effusion, the patient should be kept in bed and weight-extension applied.

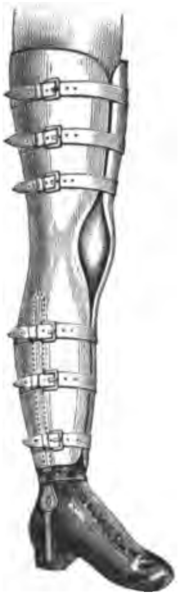


FIG. 12.—Leather splint for the knee. (Marsh and Watson's Diseases of Joints, Cassell.)

If any doubt exists, it is advisable to be on the safe side and insist on recumbency. If all pain has subsided and the limb is in good position, the patient may be allowed to get about on crutches with a patten on the other boot. The leather or poroplastic splint must never be left off during this time, and certainly not for six months after all active symptoms have subsided.

A Thomas's knee splint may be used instead, but is more cumbersome and less efficient, and is not to be preferred to a leather splint if the latter can be provided. Thomas's knee splint may be used in two forms: (1) the common form with a ring used in conjunction with a patten on the other boot; (2) the caliper splint, which is a Thomas without a ring, but with the two side-pieces turned in to fit into the heel of the boot (as in the case of the leather splint). The splint is made as if the heel was an inch longer than it is, so that when the boot and splint are on the heel falls an inch short of the sole. A V-shaped gap is cut in the back of the boot opposite the heel to prevent pressure sores. The splint should take its purchase on the descending ramus of the pubes and the tuber ischii, and should be so made that the posterior half of the upper ring is concave upwards to fit comfortably under the tuber ischii. The outer rod should extend as high as the great trochanter: the ring should here not fit closely, and should be very well padded. The inner bar should be rather in front of the middle line (Fig. 13).

In some cases Thomas's splint may be used in conjunction with a leather splint for purposes of greater security.

Flexion Deformity and Weight-extension.—If the limb is not fixed firmly in the extended position there is a great tendency for the hamstrings to overpower the extensors and produce flexion. Slight flexion is the position of greatest use, and spasm of the muscles increases it. In the later stages, when the capsule is stretched, flexion may be further complicated by displacement backward of the tibia and rotation outward of the leg, due to the actions of the semi-membranosus and biceps respectively. When cases are first seen in hospital practice there is usually some flexion, and before fixation can be adopted the spasm of the muscles must be overcome by weight-extension. Extension must always be applied with the limb in such a position that no leverage is produced. If there is leverage, the joint is the fulcrum, and the result is inter-osseous pressure and pain.

The object of weight-extension is gradually to tire out the contracted muscles, and so to overcome deformity, to separate the articular surfaces, and thus prevent and relieve pain. When weight-extension is employed to correct flexion an adjustable splint should be used (*see* Fig. 14).

When weight-extension has done its work, then treatment by fixation and rest is continued as in the early cases.

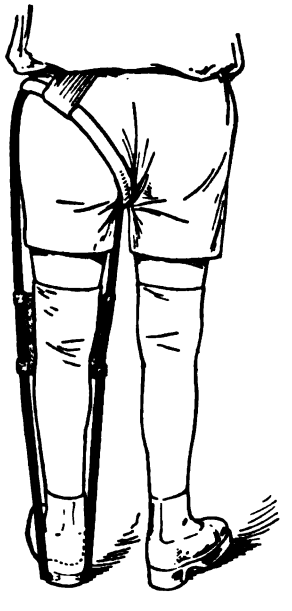


FIG. 13.—Thomas's caliper splint for the knee. (Marsh and Watson's Diseases of Joints, Cassell.)

Synovial Effusion.—During the early stages it sometimes happens that the synovial membrane becomes acutely distended with synovial fluid. It is advisable in such cases to aspirate under the strictest aseptic precautions and to draw off the fluid, otherwise the capsule becomes stretched and the function of ligaments impaired. A little fluid in the joint is a provision of nature to keep the inflamed surfaces lubricated, and so to prevent pain. Weight-extension has the same effect, and it is well to remember that weight-extension should be left on at night, otherwise children may be much troubled with starting pains, which are the result of sudden spasms in relaxed muscles. It is said that starting pains generally mean erosion of cartilage; but it is not always so. Cases are sometimes operated upon which show no erosion of cartilage, and which yet have been much troubled with these pains. The inflamed synovial membrane often overlaps the cartilage, and it is only necessary for this to be suddenly nipped between the bones to produce the same result.

Mild cases of effusion are best treated by *passive congestion* (*see* p. 751, and Bier's Method, Vol. III.).

The joint may also be strapped with *Scott's dressing*. If the pain is not relieved by weight-extension the *actual cautery* may be applied to the surface of the joint and is often beneficial.

Primary Disease at the Epiphysial Line.—When tuberculous disease of the knee commences as an epiphysitis at the lower end of the femur and the diagnosis has been confirmed by a radiograph, an attempt should be made to cut down on the diseased area without opening the joint and to scrape away all tuberculous material. If this is done early in the disease a general invasion of the synovial membrane may be prevented. It is important not to go through the synovial cavity when exposing the epiphysial line. The lateral reflection of the synovial membrane at the level of the epiphysial line can be avoided by keeping close to the posterior edge of the lateral surface of the femur. If the synovial cavity is opened, then it is advisable to pack the wound and allow adhesions to form which will shut off the general joint cavity and to gouge into the bone about two days later. When the cavity in the bone has been scraped a little iodoform powder may be put in. It is advisable to use the large flake iodoform, as less liable to produce toxic symptoms, and to mix it with 3 parts of boric powder.

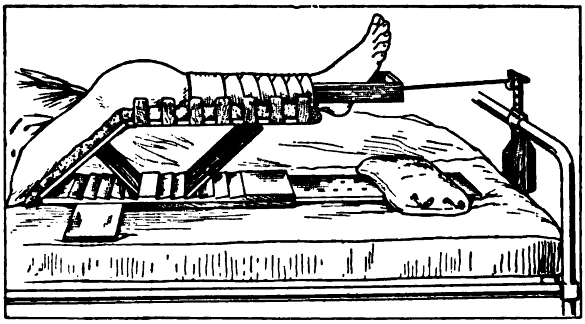


FIG. 14.—Adjustable splint for the knee. (Marsh and Watson's Diseases of Joints, Cassell.)

Caseation and Suppuration.—Pus, as soon as formed, must be evacuated, otherwise the joint will rapidly disorganise and sinuses form; the risk of secondary infection is then very great.

The great majority of cases that in former days came to amputation were the result of mixed infection; failing amputation, they frequently ended in lardaceous disease and death.

It is an extremely difficult matter to decide how far to go in operative treatment when once suppuration has occurred. The occurrence of caseation and breaking down of the tuberculous foci is often an indication that the tubercle bacilli have worked themselves out, and are being cast off by the tissues. If this is so, then all that it is necessary to do is to evacuate the waste products, keep the part aseptic and in good position, and await repair.

If evacuation can be carried out by aspiration, so much the better; if re-accumulation occurs, aspiration can be repeated. The risk of secondary pyogenic infection is always great, and drainage should be avoided if possible.

It is a not uncommon practice under similar conditions to perform a radical operation by laying the joint freely open either by turning down the patella or dividing it transversely, and then dissecting away all the synovial membrane and gouging out any bone that is diseased. This treatment will probably eradicate the disease, but will probably result in destruction of the joint as such, and end in fibrous ankylosis, which usually means an unstable limb. It is preferable to try first simple evacuation, in the hope of securing a useful joint, and later, if unsuccessful, to perform a complete erasion or excision.

In cases of mixed infection vaccines should be made from the infecting organisms and employed.

If in spite of treatment suppuration continues and the general health becomes seriously affected, amputation should be performed.

Excision and Erasion.—The great object to be attained in excision of the knee is a straight limb with firm bony ankylosis. It thus differs from all other excisions in which movable joints are desired.

The cases in which excision, with few exceptions, is advisable are limited to adults and adolescents in whom the growth of the limb is, or is nearly, complete, and the bones have acquired so firm a texture that after the operation they readily unite by an unyielding synostosis. Such cases may be arranged as follows:

Deformity.—Cases in which the joint has become ankylosed in bad position, *i.e.*, cases in which the operation is performed for deformity and not for disease (which has ceased to exist). In the well-to-do excision is seldom necessary, because treatment is usually commenced early and rigorously continued.

Disease.—(*a*) Cases in which the joint is incapacitated by incomplete fibrous ankylosis, in which by chronic inflammation extending over a number of years the synovial membrane, ligaments, and cartilages have been destroyed and replaced by fibrous adhesions, which limit but do not entirely prevent movement. Under such circumstances the joint remains irritable and painful when adhesions are stretched, and the patient is prevented from following active employment. (*b*) Cases in which the disease has commenced in the articular ends of the femur or tibia, and has resulted in the formation of a circumscribed deposit in the immediate vicinity of the joint, upon which it acts as a constant irritant.

In reference to this class, if an early diagnosis of the exact condition can be made before the joint is involved, the epiphysis may be explored through the condyles of the femur or tuberosities of the tibia, without opening the joint, and sometimes the deposit may be cleared out and an excision averted. The difficulty lies in accurate diagnosis. In these cases much help may be gained by the X-rays.

When excision is performed for active disease a very complete operation is necessary. No mere resection of bone will suffice; it must be an erasion combined with resection, *i.e.*, all diseased synovial membrane, cartilage and bone must be removed, and then the bones resected to ensure firm bony ankylosis.

The old-fashioned excision was simply a resection without attention to the other parts of the joint; it is of little use to eradicate disease, but is all that is necessary in the first class, where no disease but only deformity remains.

Contra-indications to Excision.—(1) Children under twelve; (2) senile tubercle; (3) mixed infection with signs of absorption; (4) early stages of disease before non-operative treatment has been given a fair trial.

In the first place children under twelve seldom require operation unless the joint has been neglected. Excision in the very young usually results in considerable shortening by interfering with growth at the epiphysial line, and in a union which is not firm and readily yields to deformity on provocation. Cases under (2) and (3) will, as a rule, call for amputation if any operation is demanded. Cases under (4) have already been dealt with.

Erasion.—The operation of erasion was designed to remove disease and preserve mobility. Unfortunately erasion often removes the disease without securing mobility or stability. It must necessarily be difficult to secure a stable and movable joint, which shall be functionally useful, if not only the synovial membrane is removed, but the ligaments on which the stability of the joint depends are mutilated.

It is the exception rather than the rule to secure a good movable joint after a planned erasion, and in most instances, where such a result is possible, it might be obtained by rest and fixation rather than by operation.

The verdict on erasion seems to be as follows: In the adult, when operation is demanded, erasion cannot compare with excision. It is a case of fibrous *v.* bony ankylosis. In children, in the few cases that need a radical operation, it is to be preferred to excision, because it does not interfere with growth. When employed, it must be thorough. If flexion deformity occurs after erasion, then excision must follow, when the bones have ceased to grow.

Deformity after Excision.—It is no uncommon thing to see flexion deformity after excision of the knee. Enquiry will usually elicit the information that the limb was straight on leaving hospital, and only began to bend when the splint was left off; though, sometimes owing to imperfect splinting, this takes place while the apparatus is being worn. Encouragement is given to flexion in the practice of some surgeons by fixing the limb at the operation in the position of slight flexion, as being more serviceable in that position. A slight amount of flexion gives the flexors a great chance by allowing them to act as levers.

In other cases, if any disease remains behind, especially in the neighbourhood of the epiphysial line, flexion may readily occur. Occasionally, when the epiphysial line has been encroached on at the operation in growing bones, not only may shortening result, but either genuvalgum or genuvarum from suppression of growth on one side or the other of the epiphysial line. Flexion after excision in an adult should be a rare occurrence if the operation is properly conducted in suitable cases, and if the limb is fixed in good position by suitable apparatus for a long enough period, and, of course, if no weight is borne on the limb until firm bony union has resulted. The risk of deformity occurring after excision in young growing bones must always be great, and will call for prolonged care in the after-treatment. Re-excision is often required to correct deformities which have followed excision in early life.

Amputation.—When despite treatment the disease has wrecked the joint, when sinuses are numerous and the patient shows signs of toxic absorption, amputation often becomes a necessity.

Each case must be judged on its merits, and no rules can be laid down.

Amputation is often expedient for the poor, when circumstances do not permit of prolonged treatment without the assurance of a good result at the end.

Amputation may sometimes be preferred in a case of active disease which has advanced to caseation even without much involvement of the articular surfaces.

Convalescence may then be established in a few weeks, and in a few months the patient can get about on a peg-leg, whereas by other means it may be perhaps two years before active life can be resumed, and then in all probability with a joint functionally damaged. It is necessary, too, to remember that even after prolonged and careful treatment amputation may still be required. When tuberculous disease commences late in life, repair seldom takes place, and an early amputation makes the best of a bad job.

TUBERCULOUS DISEASE OF THE ANKLE AND TARSUS.

In the ankle-joint the disease may be primary in the synovial membrane or in the bones, but more often commences in the synovial membrane. In the tarsus the primary disease is usually in the bone. Any of the bones may be involved, but the astragalus and os calcis are most frequently affected. Owing to the cancellous structure of these bones caries advances rapidly.

Primary Osseous Disease.—By means of the X-rays an early diagnosis of disease at the epiphysial line can often be made, and it may be possible to check the disease by cutting down on the bone and gouging away the tuberculous deposit without opening the joint. In the young considerable care is required to avoid such damage to the epiphysial line as will result in premature synostosis and interference with growth.

Not uncommonly the tubercle commences in the astragalus, starting beneath the upper articular surface. Should this occur the astragalus should be removed, if possible, before the joint cavity has become involved. An excellent ankle-joint can be secured after removal of the astragalus if the joint itself is not involved, and even after invasion of the synovial membrane good functional result is often restored.

Primary Synovial Disease.—If the disease commences in the synovial membrane, the case should be treated on expectant lines by rest and fixation. The ankle must be fixed at a right angle or rather less in a leather splint. If the joint is painful it should be strapped with Scott's dressing. Unless rapid improvement follows, an operation should be performed with a view to removing all diseased tissues, because there is a tendency in tuberculous disease of the ankle to progress, and the prognosis is not nearly so good as in the case of the hip or the knee.

Arthrectomy.—In order to get a good exposure of the ankle-joint it is advisable to excise the astragalus first and then to dissect away all diseased synovial membrane. The joint is best exposed by two incisions made vertically downwards just anterior to the malleolus on either side. The extensor tendons and soft parts are carefully raised from the front of the joint, and the tendons on the inner side dealt with in the same way. The capsule is then opened, the astragalus excised, and the cavity of the joint dealt with. As an alternative, a curved anterior incision may be used extending from one malleolus to the other, crossing the neck of the astragalus. The extensors tendons are divided and the joint then opened. The tendons are sutured at the completion of the operation.

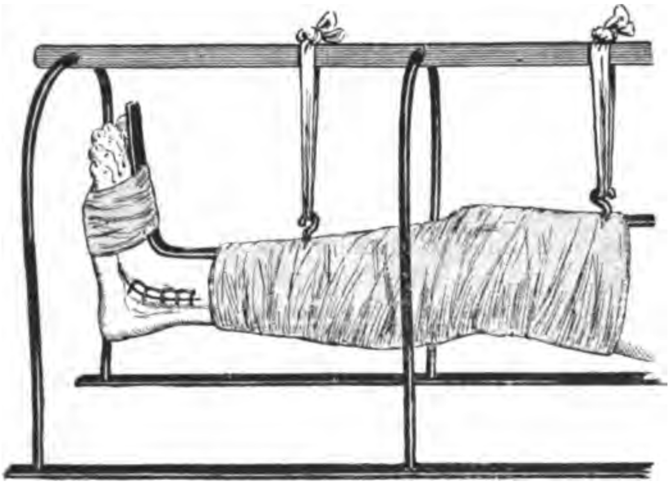


FIG. 15.—Metal Supension splint for the ankle. (Cheyne and Burghard's Manual of Surgical Treatment, Cassell.)

The functional results after erasion are quite good, provided that all diseased tissues have been removed. Care is required in fixing the joint after operation to avoid lateral deviation. The best splint to apply is a Neville (with side splints) slung in a cradle.

Excision.—A planned excision is not to be recommended. If arthrectomy is unsuitable or unsuccessful, then amputation is necessary.

Disease of Tarsus and Metatarsus.—If a deposit of tubercle occurs in the *os calcis*, it should be cut down on at once and scraped away. The cavity should be swabbed out with iodoform emulsion and the wound closed. If the os calcis is extensively involved, then excision of the bone is necessary. The functional result after removal of the os calcis is better than might be expected. New tissue forms in the heel-pad, and the ultimate depression of the heel is not nearly so great as is at first apparent. After excision the foot should be slung by means of an anterior metal splint, which is bandaged or fixed by plaster to the foot and leg, leaving the heel exposed (Fig. 15) for dressing and free from pressure.

If tubercle attacks other individual bones of the foot, early operation and primary excision, if possible, are indicated. These cases do not do well by expectant treatment, and the results from excision are good.

If there is diffuse disease of the tarsus, a scraping operation is seldom sufficient to eradicate the disease. A partial tarsectomy may be successful in some cases. In this operation the astragalus is sawn through at the neck and the os calcis at the same level; the metatarsals are sawn through on the distal side of their base, and the intermediate wedge removed. A complete tarsectomy (Mikulicz's operation) is sometimes successful; but when a partial tarsectomy is impractical, a better result is obtained by Symes's amputation, or if the condition of the skin of the heel prevents this, by an amputation above the malleoli. In Mikulicz's operation the tibia and fibula are divided above the articular surfaces, and the metatarsals through their bases. The metatarsals are then fixed to the lower ends of the tibia and fibula so that the metatarsus is brought into line with the tibia and fibula, and the metatarso-phalangeal joints take the place of the ankle-joint. It is an operation seldom practised: it is difficult to perform, and the results are not encouraging.

Amputation.—If arthrectomy for disease of the ankle-joint fails to cure, or disease of the ankle is combined with extensive disease of the tarsus, especially if sinuses have formed, amputation is called for.

The ideal amputation under these circumstances is by Symes's method at the ankle, but it is often difficult to secure sufficient healthy skin for this purpose, and if this is so, the choice lies between amputating through the lower third or at the seat of election.

Amongst the poor the latter is preferable, because a peg-leg is cheaper and more reliable than an artificial foot, which is otherwise necessary.

Deformity.—Bony or fibrous ankylosis in a faulty position may follow on recovery. The deformity which is most often seen is that of equinus, although this may be associated with either varus or valgus.

If the fixation is by fibrous tissue, the position may be corrected by tenotomy of the tendo Achillis and forcible wrenching. If firm ankylosis has occurred, the astragalus, if not already removed, should be excised and the position corrected.

No forcible movements should be employed if there is any evidence of active disease, or within a period of a few months from the cessation of active disease (*see* under Hip and Knee).

If after excision of the astragalus a useful foot is not secured and amputation is considered advisable, an excellent stump may be secured by the writer's amputation at the ankle, which leaves the os calcis together with the normal heel-pad intact. In this amputation the os calcis is wedged in and fixed between the malleoli, and the remainder of the foot amputated.

TUBERCULOUS DISEASE OF THE SHOULDER.

Tuberculous disease of the shoulder, though not uncommon in adult life, is seldom met with in children. The primary focus is more often in the bone beneath the epiphysis than in the synovial membrane. A definite history of injury is nearly always obtained, and on this account the tuberculous nature of the disease is apt to be overlooked in the early stages.

As in the case of other joints, a tuberculous focus in the bone when recognised must be operated on at once, although in the case of the shoulder it will seldom be possible to deal with the disease without opening the joint.

In synovial disease of the shoulder, pain is often a negligible quantity, and for this reason the true nature of the disease may escape detection. The weight of the arm and the extreme laxity of the capsule when the muscles waste are factors in preventing inter-osseous pressure. When the disease is advanced and muscular spasm excessive, pain is to be expected.

Recovery from tuberculous disease of the shoulder is generally followed by considerable stiffness, so that in the employment of rest and fixation it is advisable to keep the arm somewhat abducted and externally rotated, to prevent the position of fixation which takes place with the arm close to the side and somewhat inverted.

The forearm should be supported by a sling on a trough splint of poroplastic, leather or guttapercha, and the arm abducted to about 45° from the side and somewhat everted. A wedge-shaped pad should fill the gap in the axilla (Fig. 16). Counter-irritation by means of blisters or the actual cautery should be used for the relief of pain. If pain is unrelieved by this method weight-extension may be used, but this necessitates the recumbent position, and indeed is seldom required.

Operative Treatment.—When suppuration has occurred the joint should be opened and the abscess drained. Pus sometimes tracks along the biceps tendon, and an intermuscular abscess forms in the middle of the arm. The origin of this abscess may not be apparent at first sight, but marked deltoid wasting with limitation of movement at the joint serve to direct attention to the cause.

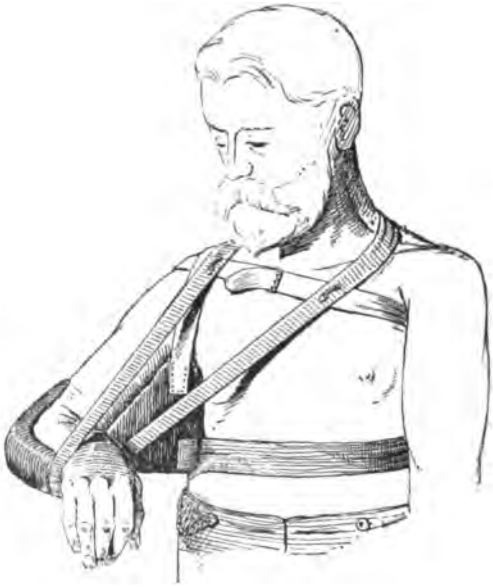


FIG. 16.—Abduction splint and pad for the shoulder. (Cheyne and Burghard's Manual of Surgical Treatment, Cassell.)

Once suppuration has occurred the prognosis as regards functional utility of the joint is bad unless further operative procedures are carried out.

An interval should be allowed to elapse after evacuation of an abscess in the joint until all acute symptoms have subsided, and then unless marked and rapid improvement follows it is advisable in an adult to excise the head of the humerus and to erase as far as possible all diseased tissue.

An incision should be made commencing just external to the coracoid vertically downwards along the anterior border of the deltoid with the arm somewhat abducted and everted. The incision is carried down to the capsule, the biceps tendon exposed, freed from the groove and drawn outwards.

The capsule is then opened, and the head of the bone pushed through the wound and sawn off. The deltoid bursa must be inspected, and if involved thoroughly scraped.

It is often possible to remove the head without interference with the muscles attached to the tuberosities; but should it be necessary to divide the bone at a lower level, these muscles must be separated sub-periosteally in such a way as not to completely detach them from the periosteum of the shaft. If the external rotators are undisturbed or regain their attachments an excellent result may be expected.

The glenoid cavity should be scraped and occasionally needs to be resected. The arm is put up in the manner already described (*see* Fig. 16).

TUBERCULOUS DISEASE OF THE ELBOW.

Tuberculous disease of the elbow very often follows on an injury, and perhaps more often than in the case of any other joint, so that very great caution is required before resorting to forcible movement under an anæsthetic for fixation of an elbow-joint resulting from an injury.

As in the case of the knee, ankle and wrist, the best method of fixation is with a leather splint, which is made to extend nearly to the axilla and close to the wrist. It should be made in two halves, which are held together by webbing straps (*see* Leather Splint for Knee).

The elbow should be fixed at rather less than a right angle, and the forearm kept midway between pronation and supination.

A good method for keeping the elbow at rest is advocated by Robert Jones. He uses a " halter " attached to the wrist and slung round the neck, so that the wrist is kept close to the upper end of the sternum and the elbow to the side. The arm is kept in this position under the clothes.

In children, if treated early, the result is usually a good movable joint. In adults fibrous ankylosis more often results. It is not advisable to delay operative treatment if the disease advances in spite of rest and fixation, because a very good result can often be obtained by excision of the joint. Tuberculous disease of the elbow is nearly always primarily synovial, and an excision must be combined with erasion of all diseased synovial membrane, especially in the region of the head of the radius.

Care must be taken not to remove more bone than is absolutely necessary to secure free movement, otherwise a flail joint may result.

The joint should be exposed by a medium posterior vertical incision, and the arm put up on an internal angular splint. Movement should be commenced after about three weeks, and special attention should be directed to pronation and supination.

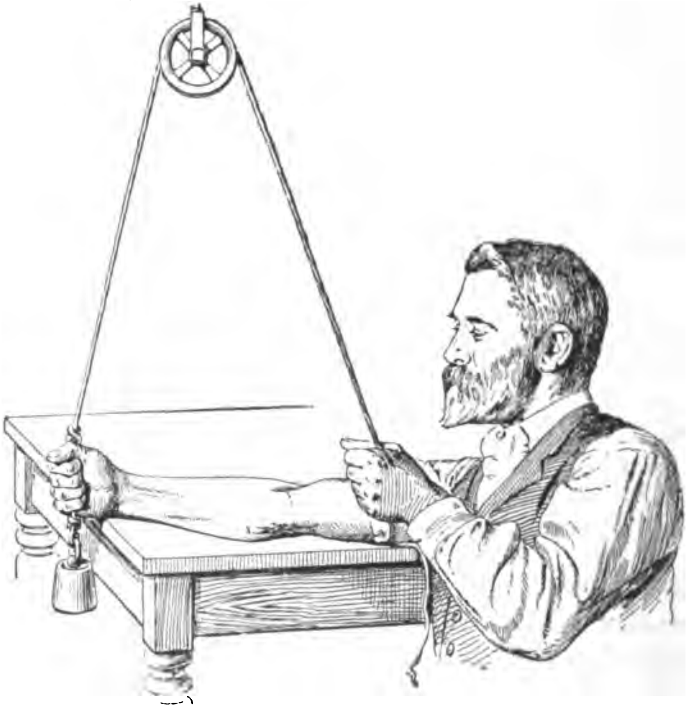


FIG. 17.—Weight and pulley for elbow exercises. (Cheyne and Burghard's Manual of Surgical Treatment, Cassell.)

It is often difficult to strike the happy medium between a flail joint and a stiff joint. If there is a tendency to a flail joint, fixation in plaster is required to promote further contraction and fixation. Excessive stiffness can be overcome with exercises in which a weight and pulley are employed (Fig. 17).

When suppuration has occurred, with or without sinus formation, an excision combined with scraping of all sinuses should be carried out without delay.

If there is evidence of a mixed infection with constitutional disturbance, amputation through the middle of the arm will be called for.

If tuberculous disease of the elbow commences in middle age or late in life, any treatment short of amputation will usually be unsuccessful.

TUBERCULOUS DISEASE OF THE WRIST.

In many instances tuberculous disease of the wrist ensues quickly after injury. The transition from the mere traumatic to the tuberculous type of inflammation is so gradual that it is apt to be overlooked.

If the disease is recognised early, the joint should be at once immobilised, so that no movement is permitted at the wrist-joint or carpal joints (which are frequently involved at the same time). This may be best accomplished by a well-fitting leather splint.

If treatment is commenced early and continued until all swelling, limitation of movement, and pain on movement have subsided, a complete restoration of function may be expected in early adult life.

In a small percentage of cases, in spite of early prompt treatment, fibrous ankylosis will result. It is therefore important that the wrist should be immobilised in that position which will secure the best functional result should ankylosis occur. When the wrist is flexed, the power to grip with the hand is greatly impaired; consequently the wrist should be fixed in the extended position, preferably somewhat hyper-extended on the forearm. The subsequent grasping power is thereby increased.

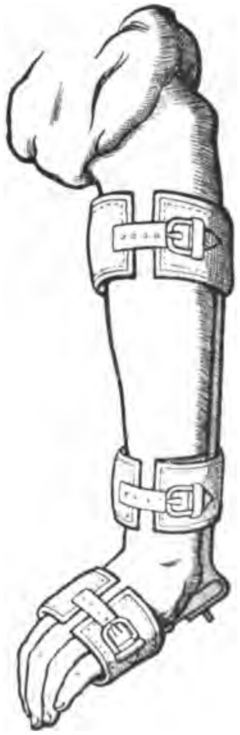


FIG. 18.—Adjustable splint for the wrist. (Robert Jones.)

The tendency of the disease is to produce flexion, and if flexion is present when treatment is commenced, steps must be taken to gradually reduce the flexion to a position of slight hyper-extension. This may be accomplished by means of a splint made of malleable sheet-metal, or by an adjustable splint with a joint at the wrist (Fig. 18).

During treatment by immobilisation the splint should be removed daily for washing, and gentle massage to the muscles of the forearm with movements of the fingers, should be employed about once a week. The greatest care must be exercised to avoid movement at the wrist and carpal joints.

The arm should be kept in a sling, with the forearm flexed to less than a right angle. A careful watch must be kept for signs of suppuration. Suppuration with sinus formation may easily occur without the knowledge of the patient and without any pain.

No operative treatment should be employed unless it is obvious that the pus intends to make its own way out. In many cases, although suppuration occurs, a cure may result without sinus formation.

Operative Treatment.—A planned excision of the wrist is seldom of use in tuberculous disease. Any attempt to arrest tuberculous disease of the wrist in the early stages by excision is not to be recommended. Excision of the wrist frequently produces a very poor functional result, whereas rest and fixation when commenced early usually result in the restoration of good movement.

In later stages, when suppuration has occurred, a scraping operation (as opposed to a planned excision) should be employed, and all diseased bone, etc., removed. Care should be taken to avoid injury to the extensor tendons and the cutaneous nerves.

Occasionally tuberculous disease of the wrist runs a rapid course, and should it be found that in spite of rest and fixation the disease is rapidly advancing, amputation through the forearm should be advised to avoid a fatal result from a general tuberculous infection.

TUBERCULOUS DISEASE OF THE SACRO-ILIAC JOINT.

Tuberculous disease of this joint is fortunately not common, and is seldom met with under the age of fifteen. Owing to the deep position of the joint, to the protection afforded by the strong posterior sacro-iliac ligaments, and to the rudimentary nature of the articulation which has no true synovial cavity, the disease may be well advanced with caries and suppuration before it is recognised.

Prolonged rest in the recumbent position is essential, with weight extension on the thigh to keep the pelvis at rest in the early stages. When suppuration has occurred the joint must be exposed and the disease dealt with. In some cases the abscess tracks inwards towards the iliac fossa and may escape detection.

Once suppuration has occurred the prognosis is bad. Should healing occur, the patient must be fitted with a Thomas's hip splint, and not allowed to bear weight on that side for at least six months.

GONORRHŒAL ARTHRITIS.

Cases of arthritis in gonorrhœa may be divided into four groups, from the point of view of treatment:

(1) *Arthralgia.*—In these cases there is pain without definite synovial swelling or effusion, and the inflammation is peri-synovial.

(2) *Acute or Sub-acute Synovitis.*—Most cases fall into this group, which is characterised by marked pain and rapid effusion, which is often turbid. One joint after another is affected. The effusion often subsides in one joint as another is infected, and relapses are common. The gonococcus can be isolated from the fluid in about two-thirds of the cases.

(3) *Chronic Synovitis and Peri-arthritis.*—Often the arthritis is chronic from the first, and is characterised by a persistent painless effusion, followed by peri-articular thickening.

(4) *Suppurative Arthritis.*—In a few cases acute suppuration occurs, and is due not to the gonococcus alone, but to a mixed urethral infection.

Local Treatment.—No local treatment can be effective until the urethral inflammation has been subdued (*see* Gonorrhœa).

(*a*) *Of the arthralgic type.*—As a rule these cases are rapidly cured when the urethral discharge is checked, especially if the arthralgia occurs during the acute stage; but when met with in association with chronic gleet the cure is not so easy.

Counter-irritation, pressure and rest are employed. The joint is painted with the liniment of iodine, enveloped in wool, and then bandaged with an elastic webbing bandage and kept at rest. The bandage must not be allowed to produce pain.

As soon as the pain has disappeared, massage should be commenced, followed by passive movements.

In the case of the hip, shoulder, and sterno-clavicular joints pressure cannot be conveniently applied, and more active counter-irritation may be used by means of a succession of blisters about 2 in. square. If the tarsal joints are involved no weight should be borne on the foot to avoid the production of flat foot.

(*b*) *Of the acute type.*—Treatment on the lines laid down for acute synovitis must be carried out. The acute inflammation must be arrested with hot fomentations, leeches or the ice-bag. Pain is often so severe that morphia is necessary.

When the acute inflammation has subsided, vigorous measures are necessary to reduce the effusion. When the effusion is excessive the joint should be aspirated and pressure at once applied. If the fluid re-accumulates then a small incision through the skin should be made, and the joint aspirated with a trocar and washed out with saline solution through a cannula.

This treatment is applicable to the knee, which is the joint most commonly affected: it is not very suitable for other joints, and is seldom required except for the knee.

When the effusion has been reduced measures must be adopted to prevent adhesions, which are very prone to occur in these cases. This is accomplished mainly by massage and passive movements.

Should effusion persist in spite of repeated aspiration or irrigation, the actual cautery should be tried. Some 200 to 300 small superficial *pointes de feu* are made over the surface of the joint and then firm pressure is applied. This may be repeated in a few days' time if necessary, and followed by passive movements and massage.

(*c*) *Of the chronic type.*—In addition to the measures already described for the treatment of gonorrhœal rheumatism and synovitis, other forms of treatment will often be required in chronic cases.

Passive congestion (*see* Tuberculous Disease) is most valuable in these cases when combined with massage.

Active congestion produced by hot-air baths and radiant heat may be alternated with passive congestion (*see* Chronic Synovitis).

When adhesions have formed and persist in spite of the treatment already described, they must be broken down by manipulation under an anæsthetic.

To promote absorption of fibrous tissue in cases of peri-articular thickening zinc ionisation is most valuable.

To restore movements of tendons and to stimulate the nutrition of the muscles surrounding the joint static wave-current treatment is strongly recommended.

(*d*) *Of the suppurative type.*—When suppuration occurs in gonorrhœal arthritis the condition is one of pyæmia, and the case is serious and must be treated on the lines laid down for acute suppurative arthritis.

General Treatment.—*Vaccines.*—When the gonococcus has been isolated from the joint cavity or from the urethra it is preferable to use a vaccine prepared from that particular strain.

In a certain proportion of cases the organism cannot be isolated, although clinical evidence of its presence is obtained. In these circumstances, and when opportunities do not exist for the preparation of a vaccine, stock vaccines should be used.

Whether a stock vaccine has been prepared from a single strain or from mixed strains is not of much importance, as the biological reactions of a typical gonococcus do not vary.

The necessity of making a thorough bacteriological investigation of the case is strongly urged, because not infrequently it happens that the arthritis is due to one of the secondary organisms so frequently present in chronic urethritis.

The more acute the disease the smaller the dose of vaccine required. In acute cases the dose should commence with four millions, rising gradually to twenty or thirty millions, with intervals of two to three days, increasing to weekly inoculations as the dose increases. In chronic cases somewhat larger doses may be used, rising to five hundred or a thousand million. This somewhat depends on the particular strain used, as some strains produce more marked reactions than others.

Under no circumstances is it advisable to push the dose so as to produce a constitutional reaction, which may aggravate the lesion. A local reaction is to be aimed at, so long as this is not too severe.

Usually following inoculation there is a slight increase in the local signs and symptoms, followed in about twenty-four hours by a diminution.

The reaction of the first inoculation is the most marked, and with each subsequent injection the reaction diminishes. The average number of inoculations required is about six.

The best results are seen in chronic cases. When vaccines are used adhesions seldom occur. In cases of arthritis with chronic gleet vaccines should always be used. It often happens that little or no progress is obtained until vaccines are employed. In acute cases the value of vaccines is not so certain, but it is advisable to use them.

Sera.—Anti-gonococcus serum (2 to 10 cubic centimètres), normal horse serum and anti-streptococcus serum have all been used with success, and these may be employed in combination with vaccines. In all probability normal horse serum (20 to 30 cubic centimètres) is just as beneficial as anti-gonococcus serum. Serum should only be used in the acute stage and cannot compare with vaccine in chronic cases. An average dose is 25 cubic centimètres, and a daily injection may be given.

Drugs.—Quinine and iodide of potassium are the most useful.

PNEUMOCOCCAL ARTHRITIS.

As a sequel to pneumonia and other pneumococcal lesions arthritis is not uncommon.

In some instances the arthritis appears to be primary, though in all probability it is secondary to some undiscovered focus of invasion in the fauces or elsewhere. In other cases the arthritis is a terminal phase in a general pneumococcal septicæmia.

Treatment.—In early cases the effusion is seldom purulent, but diplococci can usually be recovered from the fluid. The joint should be opened, irrigated with saline solution and then closed. Anti-pneumococcus serum given subcutaneously should be used early.

Vaccines should be prepared from the culture and employed as soon as possible.

In the milder cases a purulent arthritis may be prevented in this way. Should suppuration occur, the joint must be more freely opened and treated like other forms of purulent arthritis. If the pus is thick, contains much fibrin and few organisms, and these in chains not actively dividing, the prognosis is much more favourable than if the pus is thin and contains many diplococcal forms. The former is indicative of a local lesion, the latter of a septicæmia.

In washing out the joint it is important to remove all fibrinous threads, which are veritable "nests of diplococci."

In children the arthritis is sometimes the result of a pneumococcal epiphysitis, which emphasises the importance of an X-ray examination in all cases.

ARTHRITIS IN TYPHOID FEVER.

In typhoid fever joint pains (typhoid arthralgia), acute or chronic synovitis and suppurative arthritis may occur. These conditions require to be treated on lines already laid down. A special point in connection with this disease is the tendency to spontaneous dislocation of the hip as the result of effusion into its capsule. It often happens that the discovery of a dislocation is the first intimation that the hip is affected. Should a dislocation occur it should be reduced at once before adhesions and contractions occur, and weight-extension should then be applied.

A similar condition may occur in arthritis associated with other infective fevers, especially when wasting is a marked feature, but enteric fever accounts for the great majority of cases.

SYPHILITIC DISEASE OF JOINTS.

The usual remedies for the treatment of acquired and congenital syphilis will in the great majority of cases suffice to produce a complete cure when a diagnosis of specific arthritis is established.

When syphilitic disease of the joints occurs in gouty subjects it is apt to prove very indolent and intractable unless the remedies for gout are combined with the anti-syphilitic treatment.

Treatment by "606" is still on trial. Mercury and iodides should be given a fair trial in the first instance (*see* Syphilis).

In the joint affections which occur in the early stages of the *secondary* period, mercury (in the form of Scott's ointment) should be rubbed into the joints involved. At the same time mercury should be given by the mouth or by intra-muscular injection into the buttock.

Pressure and counter-irritation should be used to reduce effusion, which is sometimes so excessive as to warrant the use of the term "hydrarthrosis."

In the *tertiary* stage, when gummata form in the subsynovial tissue and are left untreated, the disease may spread not only inwards, but outwards and result in ulceration. In this way a septic arthritis may arise.

In other cases the primary lesion may be epiphysial and the joint become secondarily involved.

If the skin is ulcerated or the bone diseased it is advisable to scrape away as much gummatous material as possible, and to remove any sequestrum or diseased bone.

In all cases general treatment with mercury and large doses of iodide is necessary.

NEUROPATHIC ARTHRITIS.

Charcot's Disease of Joints.—In the earlier stages treatment must be directed towards limiting the destructive process, and to providing the joint with as great a measure of stability as possible.

When great distension of the capsule occurs, which is not uncommon in the early stages, aspiration is advisable to avoid the stretching and consequent atrophy of the capsule and ligaments, which if allowed to occur will imperil the future stability of the joint.

At the same time a splint, and in the case of the knee or hip light weight extension, should be used to ensure rest.

When the effusion has subsided, the joint should be immobilised by plaster or leather splints in the best possible position for subsequent use, and the joint relieved of the body-weight. In some instances when this course is adopted the destructive process is checked, and new bone is thrown out in such a way as to give support to the articulation. When the condition has become chronic it is still advisable to fix the joint, so as to delay, if not to check, the destruction of bone.

Thomas's knee splint may be used for the hip or knee and a leather splint for the ankle. The joints of the upper extremity should be fixed as in tuberculous disease.

Spontaneous fracture, which is not uncommon in this disease, must be guarded against.

If there is any evidence of syphilis and the Wassermann reaction is positive, anti-syphilitic remedies should be used.

A caution must be given against amputation. If ventured upon, an unfavourable result may be expected. Excision is equally to be avoided. In neither case can sound repair be expected.

Arthritis in Syringomyelia.—The arthropathy of syringomyelia may be distinguished from Charcot's joint disease by the peculiar sensory motor and trophic symptoms which are characteristic of the affection, and also by the fact that the arthritis is usually confined to the upper extremity.

The treatment of the joints should be conducted on similar lines to that described for Charcot's disease.

Septic infection not infrequently follows from trophic ulceration of the integument, and consequently suppuration is more liable to occur in the affected joints than it is in tabetic joints.

This complication usually develops in connection with the joints of the hands and feet, and may necessitate operation for the removal of sequestra. In some cases amputation, which can usually be performed without an anæsthetic, is unavoidable.

ARTHRITIS IN HÆMOPHILIA.

In the course of this formidable condition the synovial cavities the larger joints may be the seat of hæmorrhage, either spontaneous or resulting from injury.

If the true nature of these cases is not recognised, very grave results may ensue. Death has resulted after incision into a hæmophilic joint. Fortunately the patients themselves or their parents are generally from previous experience so alive to the dangerous consequences of a wound or other injury that they mention the fact that they are "bleeders."

When a hæmorrhage has occurred into a joint, the limb should be fixed on a splint and lead lotion or ice applied. If the hæmorrhage continues, the limb must be elevated and firm pressure applied. During attacks of hæmorrhage from other parts any joint that has previously suffered must be carefully protected from injury.

When the hæmorrhagic effusion has subsided, gentle massage combined with hot-air or radiant-heat baths should be used to prevent adhesions and promote absorption.

In treating a joint already damaged by old hæmorrhage it is important to remember that any violence may produce a fresh attack. Treatment should consist mainly of electrical and hydrotherapeutic measures.

Injections of normal horse serum are believed to diminish the tendency to bleed in hæmophilics, and may be used subcutaneously in doses of 20 cubic centimètres both as a prophylactic and during the attacks. Gelatine internally is believed to cause more rapid clotting, and may be tried during an attack: 6 oz. of a 10 per cent. solution may be given three or four times a day.

Other drugs occasionally used are thyroid extract (5-gr. doses), calcium chloride and calcium lactate (10-gr. doses).

NERVOUS MIMICRY OF JOINT DISEASE.

The main characteristic of the so-called hysterical affections or neuromimetic joints is that they depend on some disturbance of the nervous system unassociated with any defect of structure that can be detected.

A sound diagnosis is essential to successful treatment, and must therefore be briefly referred to.

The principal symptoms of organic disease are pain, swelling, heat, stiffness and muscular wasting.

In neuromimesis pain is usually out of all proportion to the other signs of disease. Swelling in most cases is entirely absent, and the joint is not only free from an increase of heat, but is often colder than natural, though subject to occasional flushings. Stiffness is usually present in an exaggerated degree, and the posture of the limb often the reverse of the position of greatest ease, and liable to variation. Muscular wasting, though occasionally present to a slight degree, is more often absent.

If organic disease is absent stiffness will disappear under an anæsthetic, the pain will not interfere with sleep or the appetite, and the tenderness will vanish when the mind is diverted or thrown off its guard.

It must not be forgotten that structural joint disease and hysteria may occur together, and that the prominence of the hysterical condition may obscure the structural changes.

General Treatment.—Iron and other tonics must be given, and any bodily disorder, such as irregular menstruation, corrected.

The patient's mind must be diverted from the malady by a change of scene and surroundings.

The confidence of the patient must be secured by an assurance that recovery is certain to follow a definite line of treatment.

Local Treatment.—Any abnormal position which the limb has assumed should be corrected under an anæsthetic. This should be followed by the application of weight-extension or a temporary splint before the patient recovers from the anæsthetic. Daily massage and passive movements must be carried out from the first.

In the intervals of active treatment the joint should be kept warm and in a comfortable position by the use of splints or sand-bags.

Hot douching should be combined with massage and passive movements: vibratory massage and faradic stimulation are also valuable.

The faradic current should be applied to the muscles in the neighbourhood of the joint. The electrodes are wetted and moved over each muscle in turn, and the current should be strong enough to secure vigorous contractions.

In rare instances of long-continued contraction tenotomies may be necessary before the normal position of the limb can be restored.

In obstinate cases which resist treatment on the lines laid down, it is advisable to adopt a strict form of Weir Mitchell treatment. The patient must be rigidly isolated from her friends and placed under a nurse with sole charge. For the first few weeks the patient is kept in bed and the muscles of the entire body vigorously massaged. For the first few days the diet should consist solely of milk, which is steadily increased in quantity. Solid food is then commenced and gradually increased until the patient is taking three large meals a day in addition to the milk. During the whole of this time the affected joint is treated on the lines already laid down. As soon as improvement commences the patient is allowed up and daily exercise permitted.

C. GORDON WATSON.

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AMPUTATIONS.

GENERAL CONSIDERATIONS.

An amputation may be performed through one of the segments of a limb or digit, or through one of the intervening articulations. In the former case the procedure is sometimes termed "amputation in continuity," in the latter it is more correctly described as a "disarticulation."

The main conditions which call for amputation or disarticulation are the following: (1) Trauma; (2) Inflammation and its effects; (3) New growths.

Amputation in Traumatic Cases.—Primary amputation, by which is meant an amputation performed within the first twenty-four hours following injury, is not undertaken so frequently nowadays as formerly owing to the fact that even in cases of very severe injury the damaged parts may often be preserved. There are instances, however, in which conservative surgery is not equal to the requirements demanded of it, as, for instance, when the main blood-vessels and nerves are all torn or where the tissues are mangled and the bones excessively comminuted. Nerve injury alone may be treated by careful suturing; a torn main artery does not necessarily indicate amputation as the collateral circulation will probably prove adequate. Excessive destruction of skin was formerly regarded as a distinct indication for primary amputation, but at the present day large areas denuded of integument may be treated by Thiersch's method of skin grafting either immediately or after the large wound has commenced to granulate.

It was not uncommon in former years to employ primary amputation following extensive compound fractures, but now the tendency is rather to rely on conservative measures. Each case must be taken on its merits, and it will often require a keen discriminating sense to decide as to which course of treatment should be adopted. If the patient is young and healthy, and provided that time and expense are no object, the surgeon will incline, if possible, to treatment by conservative measures. If, on the other hand, the patient is advanced in years or in feeble health a primary amputation will probably be better.

The most important question which arises in these cases is the possibility of being able to carry out the conservative form of treatment under aseptic conditions. Old and debilitated people may not be able to withstand the strain inflicted by a prolonged period of suppuration with its attendant toxæmia whereas they may do well if an amputation is performed. With individuals in poor circumstances or with those of the artisan class an amputation may be better than a prolonged attempt to save the limb, as the latter, in view of the serious damage to the tissues, may be of little functional use subsequently.

Amputation for Inflammatory Conditions, including Gangrene. *Gangrene.*—In cases of limited gangrene the necrotic tissues may be cast off and the wound may heal quite satisfactorily. As a rule, however, when part of a limb separates as the result of gangrene the stump which is left is pointed, the bone is exposed, and the surrounding tissues will have retracted considerably. An amputation, therefore, will be necessary in order to secure a proper stump.

In amputation for senile gangrene the chief point to be considered is the blood-supply of the tissues in the field of operation. Thus, in cases of senile gangrene of the foot it would be advisable to amputate through the knee or through the lower third of the thigh where the condition of the vessels is more likely to be satisfactory rather than lower down the limb where advanced arterial disease (atheroma) would place the circulation at a great disadvantage. The risk of amputating in cases of gangrene is greatly increased if septic complications supervene. In the gangrene that is associated with diabetes the risk of coma following operation must be considered.

Inflammatory Conditions.—Acute septic processes, or those of a chronic type, which run a prolonged course and are attended by profuse suppuration, may occasionally demand amputation. Among the acute infections may be mentioned infective osteomyelitis of a diffuse and exhausting type; septic cellulitis which tends to spread centripetally with severe constitutional disturbance and in spite of milder forms of treatment; certain forms of arthritis such as the acute septic type, or the tuberculous variety, in which the joint is so extensively disorganised that the prospect of recovery by conservative measures cannot be regarded as likely or indeed possible.

Another condition which may clearly need amputation is chronic ulceration of the leg, where the ulcer has been of long standing and has spread almost, if not quite, completely around the limb. In such cases the foot and other tissues beyond the ulcer are often excessively swollen and hypertrophied, their appearance being that of pseudo-elephantiasis. Such ulcers are most difficult to heal, and even supposing that this is accomplished by means of skin grafting, there is always the greatest risk of the entire area breaking down again and fresh ulceration starting as soon as the patient proceeds to get about.

Amputation for New Growths.—When the growth, usually a sarcoma, involves one of the bones of a limb, amputation is required as a rule, and is performed well to the proximal side of the disease, preferably through the nearest joint, so as to secure the removal of the entire bone and the lymphatics which are in connection with it.

In some cases of sarcomata, especially those which originate in the medulla and are of the myelogenous type, it may be safe to substitute resection of a portion of the bone for amputation.

Epitheliomatous growths sometimes originate in the limbs, not infrequently in old cicatrices or in ulcers of long standing. When these have infiltrated beneath the superficial tissues it may be better practice to amputate rather than rely on local excision.

Amputation Flaps.—These vary much in different cases, depending upon the tissues which they contain, their shape and the aspect of the limb from which they are obtained. As regards their constituent parts these may consist only of the skin and superficial fascia, or they may include, in addition, the deep fascia and the subjacent muscles. In shape the flaps may present a rectangular outline, but more frequently they are U-shaped; this is the better form of flap. As a rule flaps are raised from the anterior and posterior aspects of the limb, but occasionally they are arranged laterally. They may be equal in length, or one may be considerably longer than the other. In some cases there is but one flap, which is made of sufficient size to cover the face of the stump and reach the opposite side of the limb without tension.

The Vitality of the Flaps.—A high degree of vitality in the tissues of which the amputation flaps are composed is very essential as it promotes rapid union and a soundly healed stump. There are many ways, however, in which the vitality of these tissues may be compromised. Foremost amongst these may be mentioned wounding the blood-vessels which vascularise the flaps. When raising superficial flaps this accident may occur through not keeping the cutting edge of the knife against the deep fascia but allowing it to score the subcutaneous tissue. It may also occur in the case of muscular flaps if the main vessel is wounded at some distance above the free margin of the flap. Other causes of loss of vitality of flaps, which should be carefully avoided, are an undue amount of pressure exerted by the dressings or by the splint, also excessive traction on the flaps when these are too short and can only be brought together under a high degree of tension. Rough manipulations tend to damage the tissues and should be avoided. The avoidance of septic complications must be the indefatigable aim of the surgeon. In many instances the flaps possess a low degree of vitality, but, nevertheless, with care and attention to details the course of healing progresses satisfactorily. Should septic infection occur, the risk of sloughing would be very great owing to the poor vitality of the tissues and their low resisting power.

Conditions Essential for Good Flaps.—The following are the more important:

(1) The tissues composing the flaps should be healthy and well vascularised, otherwise the process of healing may be slow or imperfect, and the resulting stump may not be well adapted to withstand pressure.

(2) In shape flaps should be broadly U-shaped, that is, as nearly as possible rectangular in outline with the angles rounded off. One of the commonest mistakes made by beginners, and especially in operations upon the cadaver, is to fashion flaps which have a pointed or V-shaped outline.

(3) The cutaneous margins of the flaps should be cleanly cut, and the plane of section should be accurately at right angles to the surface. They should not present a sloping or bevelled plane of section, nor should they be lacerated, bruised or accidentally perforated.

(4) The flaps should come together without tension, but, at the same time, without presenting any obvious redundancy.

In estimating the length of flaps due consideration should be given to the amount of retraction likely to take place after they have been divided. As a rule it may be taken that the tissues of which a flap are composed retract about one-third of their original proportions. Thus, if it be desired to have a flap of 2 inches, the measurement should provide for a flap of 3 inches. Furthermore, during the course of healing, even under aseptic conditions, a certain amount of retraction take place. Therefore, if the flaps merely meet at the time of operation, they may be subjected to a certain amount of strain subsequently.

The Amputation Stump.—In every amputation the aim of the surgeon should be to provide a stump which as regards function is as perfect as possible, and one which inflicts the minimum of inconvenience upon the patient. Such a stump will be capable of movement and of bearing considerable pressure without causing pain and discomfort, and, furthermore, it will be one to which an artificial limb can readily be adapted.

Inability to bear pressure against the end of the stump is a serious fault. It may be due to a redundancy of the soft tissues, but far more frequently the cause lies in an insufficiency of tissue. This condition is usually present in stumps which are pointed or conical. In these the flaps may not have been of adequate length to cover the bones without tension, or sepsis may have occurred with subsequent sloughing and retraction of the tissues and cicatricial changes. Following amputations in children a tendency to conical stump may be occasioned by excessive growth in the bone subsequently.

Pain and tenderness on pressure may be a great source of trouble, and may diminish the functional capacity of the stump to a great extent. Various causes may account for this pain; the more constant are adhesion of the cicatrix to the bone and periosteum, inclusion of the divided end of a nerve in the cicatrix, exposure of the cicatrix to pressure or traction, or projecting sharp spicules of bone.

Adhesion of the cicatrix to the bone is often a sequela of sepsis in consequence of which the muscles retract and a large amount of cicatricial tissue is formed. Another cause of excessive fibrous tissue formation is the accumulation of a quantity of blood between the flaps in the form of a hæmatoma and its subsequent organisation. The rigidity of the tissue at the end of the stump causes tension on the nerves which are embedded in it and pain.

The inclusion of a sensory nerve in the cicatrix may require an operation for the excision of its bulbous extremity, or a second amputation may require to be performed at a higher level.

Faulty arrangement of the flaps may result in a cicatrix which will be exposed to pressure. A terminal cicatrix is to be avoided when pressure must be borne on the extremity of the stump as in the case of amputations through the fingers, or in the lower limb below the knee. Some tissues are well adapted to withstand pressure, notably those of the sole of the foot and the palmar aspect of the hand and fingers.

In some cases of pain in amputation stumps a skiagram will reveal sharp spines or spicules projecting from the sawn extremity of the bone. Those are best avoided by making clean sections with the saw, avoiding splintering or leaving behind partially detached shreds or flaps of periosteum. Sharp bony angles, such as the projecting crest of the tibia, should be removed and the bone rendered quite smooth.

When septic changes occur in the stump the cut end of the bone may become tender in consequence of inflammatory changes (osteitis).

AMPUTATION BY THE CIRCULAR METHOD.

As described in text-books of surgery, this variety of amputation is usually performed in a way which savours of antiquity. A large clumsy knife is taken, and, while grasped firmly in the operator's hand, it is made to cut the tissues of the limb circularly, the superficial tissues being divided at a lower level than the muscular strata.

No doubt such a method could claim the merit of being rapid of execution, and this was a material advantage in bygone times before anæsthesia was employed. Nowadays, however, excessive speed is not essential, and accordingly there does not appear to be any valid reason for retaining this antique method of operating. A knife resembling a large scalpel, or one such as is frequently employed in the radical operation for breast cancer, is greatly to be preferred to a large, clumsy, amputation knife.

In performing a circular amputation, the surgeon stands to the right of the limb, which he grasps with the left hand above the site of amputation, and retracts the tissues upwards. His assistant, who stands opposite to him, may aid in the retraction. The knife is grasped in the right hand in the same way as the bow of a violin, and is drawn smoothly and evenly across the under-surface of the limb from the far side towards the surgeon, dividing the superficial tissues perpendicularly to the surface and not in a slanting or oblique direction. The incision is then completed on the upper aspect of the limb, the same precautions being taken. It is quite unnecessary to effect a complete circular incision by a single sweep of the knife.

Having obtained the fullest retraction of the superficial tissues, the superficial muscular fibres are divided in a similar manner, and while steady upward retraction is maintained, the various muscular strata are successively divided, each stratum at a higher level than the preceding one. The deepest fibres are severed along with the periosteum. The bone is then sawn transversely at the required level.

When the tissues which have been retracted in the way just described are drawn down, the cut surface will present a cone-shaped appearance, the cut surface of the bone lying deeply at the apex of the cone. The divided tissues will be found to lie easily over the bone. The cutaneous margins are brought together and sutured in the transverse axis of the limb.

Advantages Claimed for the Circular Method.—An amputation performed in the manner just described can be executed rapidly, and the method of its execution is simple. The area of divided tissue is of smaller extent than in other amputations where flaps are raised. From the way in which the tissues are divided this method is well calculated to preserve a good blood-supply to the tissues forming the stump. Another advantage claimed for it is that it entails but little sacrifice of healthy tissues.

Disadvantages of the Circular Method.—A circular amputation entails a terminal cicatrix, and this is a material objection if the amputation is performed in a locality where pressure will subsequently be borne by the end of the stump.

In a muscular limb a circular amputation will be attended with difficulty in so far as regards the exposure and sawing of the bone at the required level.

This amputation is most readily effected in a limb presenting a cylindrical outline, but it may be difficult, or impossible, if the limb is conical in shape, the difficulty consisting in not being able to obtain the necessary degree of retraction of the superficial tissues.

THE MODIFIED CIRCULAR AMPUTATION.

The great advances which have taken place in operative surgery since the introduction of anæsthetics and the perfection of aseptic technique have removed the necessity for extreme rapidity, and have rendered the risk of wound infection almost *nil*. For these reasons mainly the circular form of amputation is now seldom performed, but has been largely superseded by the modified circular method.

This form of amputation consists in raising two cutaneo-fascial flaps, followed by circular division of the muscular and periosteal strata at the level of the bases of the flaps, and section of the bone as in the circular amputation.

The approximation of the skin flaps over the deeper tissues is more accurate with this than with the circular method, and it avoids the formation of lateral projecting angles at the extremities of the line of union. This amputation, too, diminishes the danger of a redundancy of soft tissues, which might have the serious effect of preventing the skin margins from coming together without traction.

When the flaps are of equal length, the cicatrix will, of course, be terminal, but if this is considered inadvisable the difficulty may be overcome by making one flap longer than the other.

AMPUTATION BY FLAPS CONSISTING OF SKIN AND MUSCLE.

The extent and relative positions of the flaps having first been determined, the surgeon stands on the right side of the limb and places the tips of his left thumb and index finger on opposite aspects of it, so as to indicate the points where the vertical limbs of his incisions are to terminate above, usually a short distance below the proposed plane of section of the bone. Keeping his fingers placed thus to serve as guides, he marks out the flaps by incisions which do not penetrate deeper than the superficial fascia. The cutting edge of the knife must be maintained carefully at right angles to the surface of the skin all the time so as to avoid slanting or bevelled incisions. It will usually be advisable also to cut with a sawing movement of the knife, but more especially where the integument is tough, as in the sole of the foot. The division of the deep fascia and muscles is commenced at the level to which the skin will have retracted, and is carried towards the bone in an oblique direction through the muscles so as to reach the bone at the base of the flap. A flap thus fashioned is shaped like a wedge, being thickest at its base and gradually tapering towards its free extremity. When both flaps have been raised, the periosteum is divided circularly and the bone sawn across. Excellent results may be obtained by this method when applied to those portions of the limbs which are thickly covered by muscle, such as the thigh. With this form of amputation a large wound area is exposed, and it is of great importance that careful asepsis should be observed.

AMPUTATION BY A RACKET INCISION.

In this amputation an incision carried circularly or obliquely around the limb or one of the digits is supplemented by a vertical cut. This latter, which varies in extent in different cases, must be so arranged as to avoid section of important vascular and nervous structures.

When this amputation is applied to one of the limb segments the circular or oblique incision is made through the skin and subcutaneous tissue, and the vertical incision is also made in the required direction. The muscles are divided circularly at the level of the retracted skin, and the bone is denuded of its investing tissues up to the level at which it is to be divided; it is then sawn through and the limb removed.

This form of amputation is usually employed also for disarticulations at the metacarpo-phalangeal joints of the hand and for the corresponding joints of the foot; it is the method of choice also for disarticulating at the shoulder and hip-joint. It enables the soft tissues to be preserved for a considerable distance below the level of bone section or disarticulation, as it affords great facility for exposing the bone high up; it is useful, therefore, in the localities just indicated where a large amount of tissue is needed for covering the stump.

IRREGULAR FORMS OF AMPUTATION.

It will frequently happen, especially in traumatic cases where the tissues have been crushed and torn, that none of the typical methods of amputation described appears exactly suited to the condition of the parts, as its rigid application would entail unnecessary sacrifice of the uninjured and healthy tissues. This is especially liable to occur in cases of injury to the fingers, where even a slight addition to the length of the stump may enormously increase its functional utility. The surgeon must, therefore, deal with each case on its merits, and so modify the lines of incision or the fashioning of the flaps as to produce the best possible results. In dealing with damaged fingers it is preferable to simply trim and suitably adjust the torn tissues than perform a typical amputation at a higher level, even though such a course may entail a greater risk of septic infection occurring in the wound.

TECHNIQUE IN AMPUTATIONS.

Disinfection.—Every effort should be made to promote healing by first intention as a satisfactory result is not likely to be obtained if suppuration occurs. The field of operation, therefore, must be rendered as nearly sterile as is possible by a thorough mechanical cleansing supplemented by the use of antiseptics. When the operation is required in traumatic cases, or in those of a suppurative or gangrenous nature, the difficulty attending this process of disinfection is very great. In septic cases the tissues are in a highly infective condition, and it is desirable that they should be completely isolated from the area of operation. This is best effected by wrapping the part in sterilised towels or swabs rinsed out of some antiseptic solution, such as biniodide of mercury (1 in 1,000). Similarly, extra precautions must be observed when the amputation concerns those regions of the body which are more exposed to contamination and more difficult of sterilisation than other parts, such as the hand, the foot, the perineum, the groin, and the axilla.

When the degree of sepsis occurring in the amputation wound is considerable, and provided the wound area is extensive, the results may be very serious. Acute inflammation affecting the flaps may lead to sloughing of the skin and other tissues or to gangrene of the stump, and this will be more likely to occur if the involved tissues are not provided with a good blood-supply. In addition to these local results of sepsis the patient will suffer from the effects of toxic absorption, and possibly the septic infection may assume the form of a bacteriæmia and become generalised (septicæmia or pyæmia). Another unpleasant consequence of sepsis is osteitis and osteomyelitis in the bone. Necrosis may follow, and in the absence of other complications a troublesome sinus may remain for a long time before the sequestrum separates. Secondary hæmorrhage from an amputation stump is most likely to occur under septic conditions, and is one of the accidents which should be borne in mind. The process of healing in a stump which has suppurated is accompanied by the formation of a large amount of fibrous tissue and an excessive degree of retraction of the tissues. These cicatricial changes are usually the cause of adhesion of the cicatrix to the periosteum and bone, and the retraction of the tissue results in a pointed or conical form of stump which may subsequently detract greatly from its functional capacity.

The Control of Hæmorrhage. *The Tourniquet.* — The old-fashioned form of tourniquet, of which that of Petit was the best example, is seldom used now; it has been largely superseded by the elastic tourniquet introduced by Esmarch. This latter which consists of a stout piece of cylindrical rubber tubing, is simple, can be readily applied, and is not liable to slip. It maintains an even degree of constriction on all aspects of the limb, and consequently it is calculated to produce occlusion of the vessels without injurious localised pressure. An additional advantage is that it can be easily sterilised by boiling.

The main disadvantage attending the use of the tourniquet is that which results from the temporary vasomotor paralysis which takes place in the vessels situated on the distal side of the seat of constriction when the tourniquet is removed. The great vaso-dilatation which results may be followed by free oozing of blood from minute arterioles and capillaries.

Another objection to the elastic tourniquet is the possibility of a temporary paralysis of the limb from excessive compression of the main nerves; this accident, however, is very rare.

The tourniquet should be applied at some distance above the proposed site of amputation, otherwise it may impede the operator and interfere with the retraction of the tissues in raising the flaps preparatory to sawing the bone.

Sometimes the application of the tourniquet is preceded by compression of the limb with Martin's elastic rubber bandage rolled from below upwards, the object being to empty it of blood as much as possible. This practice is not free from risk. It may cause embolism through the detachment of a piece of clot from a thrombus in one of the veins. Furthermore, it may spread infection of a septic or tuberculous nature or disseminate malignant disease. A much safer method is to facilitate the venous return by holding the limb in an elevated position for a few minutes before applying the tourniquet.

When the amputation has been completed and the main vessels ligatured the tourniquet should be relaxed and the smaller arterial branches secured before the flaps are brought together by sutures.

Digital Compression.—The main artery of the limb may be controlled by an assistant who exercises digital compression above the site of amputation. In this way the degree of compression can be accurately regulated so as to control the circulation without submitting the veins or nerves to compression. In amputation through the hip-joint the common iliac artery may be securely compressed by an assistant's fingers introduced through a small wound in the abdominal wall at the outer border of the rectus muscle. Another method, recommended by Sir William MacEwen, is that by which the abdominal aorta is compressed by the closed fist of an assistant applied just below and to the left of the umbilicus. This can be readily accomplished without danger in young subjects or in adults of a spare type.

Exposure and Ligature of the Main Vessels before Division.—In certain amputations, of which that through the shoulder-joint is a good example, the main vessels may be exposed and ligatured before division in the process of fashioning the flaps. The smaller arteries are caught successively in forceps as they are divided.

Instruments.—The following are the instruments usually required in the performance of a typical amputation : One or more knives of the scalpel pattern ; one pair of toothed dissecting forceps ; twelve or more hæmostatic forceps ; scissors, straight and curved ; retractors, either of metal or composed of strips of linen ; blunt dissector ; aneurysm needle ; rugines ; saw with movable back, or one of the ordinary meat-saw pattern ; needles, straight and curved ; drainage tubes ; tourniquet and elastic bandage.

Knives.—Those of the scalpel pattern suffice for most amptations. They may be had in various sizes, graded to meet individual requirements. The so-called breast knife is well adapted for many amputations where considerable masses of tissues have to be divided. In certain cases special forms of knife are usually employed.

Thus, in amputation through the ankle-joint a stout knife devised by Syme, whose name is associated with this amputation, is usually employed.

In amputations through the fingers, a long straight bistoury, commonly called a finger knife, is the instrument of choice.

Formidable-looking knives with long blades equal to one and one-half times or twice the diameter of the limb have been, and are still, used by some surgeons. They have largely fallen into disuse, however, and are rarely employed nowadays.

Fashioning of Flaps.—Amputation flaps have already been considered in a preceding paragraph (p. 795). The chief points to be attended to in raising flaps are to provide ample covering for the bone, to maintain a good blood-supply, to damage the tissues of which the flaps are composed as little as possible, to divide the skin at right angles to the surface and not in a slanting direction, and to avoid flaps which end by pointed extremities; they should be broad and U-shaped.

The Bone Section.—The tissues being well retracted out of the way, the surgeon selects the level at which the bone is to be sawn, and places the tip of his left thumb against the bone to act as a guide and steady the saw. The latter is made to engage in the bone by drawing it at first lightly and steadily a few times from heel to tip, the tip of the surgeon's left thumb meanwhile steadying the saw until the groove is deepened. The saw now travels with a to-and-fro movement, the surgeon availing himself of the entire length of the cutting edge. The saw must not be tightly gripped nor pressed with force against the bone, it cuts through merely by its own weight. As the section approaches completion the sawing movements become slower and more gentle, and the assistant who has charge of the distal segment of the limb must be careful to hold it in such a way that the saw-cut is not closed upon the saw so as to lock it, nor opened out to such an extent as to fracture the bone still uncut. By attending to these details a smooth sawn surface will be obtained without splintering or fracture. Should any sharp angles remain after the section has been made they should be rounded off, and for this purpose the saw is better as a rule than bone forceps.

The Periosteum in Amputations. (1) *Periosteal Flaps.*—Septic infection frequently involved the cut extremities of bones after amputations in the pre-antiseptic period, and it was mainly to prevent this complication that flaps of periosteum were raised and subsequently drawn over the divided bone so as to seal up the medullary cavity. Flaps of periosteum are but seldom employed now, one of the chief objections to them being that they are calculated to promote a painful and tender condition of the stump. The membrane itself is sensitive and is not well adapted to withstand a high degree of pressure, and, besides, it has been shown by X-rays that when flaps of periosteum are raised, sharp spines or outgrowths of bone frequently develop from it, and provide an additional factor in rendering the stump tender to pressure and diminishing its functional capacity.

(2) *Osteo-periosteal Method.*—By this method a layer of bone is raised together with the periosteum, a wire saw being usually employed for the purpose. This is sometimes known as Bier's osteo-plastic method. The osteo-periosteal flap is fashioned in such a way that it will fit readily over the sawn surface of the bone in the stump. Considerable time is wasted in raising flaps of bone and periosteum and there is no evidence to show that this method possesses any obvious advantages over the following:

(3) *Aperiosteal Method.*—When the bone has been fully exposed at the level at which the section is to be made the periosteum is divided cleanly and accurately all round with a sharp knife before the saw is applied. No shreds or jagged ends of periosteum are left, and when a stump treated in this way is examined by X-rays after an interval of some weeks or months it will be found that the condition of the bone is eminently satisfactory, being smooth and evenly rounded off. No evidence can be found of osteophytic growths, and the stump will be found to bear pressure very well. This is the simplest way for dealing with the periosteum in amputations, and accordingly it is to be recommended in the majority of cases.

Blood Vessels.—As a rule the blood vessels are secured after their division. Those of large size are ligatured, but small arteries may be dealt with satisfactorily by torsion or by the temporary application of clip forceps. In certain amputations, as, for example, those through the hip and shoulder joints, the main vessels are sometimes exposed and secured by ligature before division.

When ligaturing a large divided artery the extremity of the vessel should be carefully defined, and the ligature applied at a safe distance above the seat of section. In some cases, however, it may be well to include some of the surrounding soft tissues in the grasp of the ligature, more especially when the vessel is surrounded by masses of contractile muscle. This precaution diminishes the risk of the ligature subsequently slipping off. Carefully prepared catgut (size No. 1) is the best ligature material to employ as a general rule for vessels of the size of the femoral or brachial.

Nerves.—All nerves which can be identified should be cleared of the surrounding tissues, drawn down and divided 1 or 2 inches higher up than the tissues in the flaps. This precaution is taken in order to prevent the divided extremities of the nerves from becoming included in the tissues of the cicatrix and occasioning severe pain.

Wound Suture.—In some amputations the deeper tissues are connected by buried sutures over the divided bone. In adjusting the margins of the skin flaps the best method is to place an interrupted suture of silkworm gut first through the mid-point of each flap and tie it so as to subdivide the wound into two equal parts. Each of these is further subdivided into two, and, if necessary, still further subdivision is made by additional interrupted sutures. In order to secure accurate coaptation of the skin margins a fine continuous suture may be run from one angle of the wound to the other, or a series of Michel's metallic clips may be applied in the intervals between the interrupted sutures.

Drainage.—In the majority of the larger amputations drainage is necessary, and may be promoted by tubes of rubber or glass. As a rule, drainage should be employed where there is reason to suspect free capillary oozing after closure of the wound, where there is considerable risk of septic infection, and where extensive areas of tissue have been divided. A collection of blood between the flaps, apart from the danger of septic infection, delays healing, and the organisation of a large mass of blood-clot entails the development of a mass of contractile fibrous tissue in the stump and a wide retraction of the divided muscular strata. It tends, therefore, to the formation of a conical stump and a cicatrix which adheres to the bone.

Dressings.—The wound having been sutured and drainage established, the suture line and the surrounding skin are wiped over with an antiseptic solution, such as biniodide of mercury (1 in 1,000). The surface is then dried and the dressing applied. This consists of some dry sterile muslin swabs and some layers of sterile gamgee tissue. The bandage is applied evenly and with a moderate degree of firmness. If no drainage tube has been introduced this dressing need not be changed for some days, by which time some of the sutures may be removed. Drainage tubes will be removed after twenty-four or forty-eight hours and fresh dressings applied. A drain should not be employed a moment longer than is necessary as its retention in the tissues favours the extension of septic infection from without inwards along the track of the tube. The deeper silkworm gut sutures need not be removed until the tenth day, or even later.

Should suppuration occur in an amputation stump the sutures must be removed to such an extent as to provide discharges with the freest possible exit, and hot, moist antiseptic dressings are applied. Boracic lint rinsed out of boiling water answers well for this purpose. These warm fomentations will be renewed as often as is necessary until the process of healing by granulation is well advanced.

Dangers and Complications. (1) *Shock.*—The main factors which contribute to bringing about a marked degree of shock after amputation are; the division of large nerve trunks; close proximity of the seat of amputation to the trunk, and the length of time occupied in effecting the amputation.

When primary amputation is required in certain cases of trauma, evidences of the shock caused by the injury may still be present when the amputation is undertaken, and every effort must be exerted to prevent its aggravation.

Where an amputation entails the division of large nerve trunks, such as the cords of the brachial plexus, the injection of a local analgesic, such as novocaine, into each nerve before division, is to be recommended with a view to lessening shock.

The employment of spinal anæsthesia has been found to possess a distinct advantage over general anæsthesia by ether in preventing shock when amputations are performed in the lower limb; indeed, it is in cases of this kind that spinal anæsthesia finds one of its chief indications.

Other precautions for diminishing shock consist in operating in a room or theatre suitably heated, and in carrying out the steps of the operation as quickly as possible, consistent with efficiency.

(2) *Sepsis.*—This may be due to faulty technique, but in some cases, such as those that are undertaken for severe injuries or for virulent septic conditions, it may be difficult to prevent infection of the amputation wound. Such infection may be of a trivial nature, and be capable of being brought to a standstill quickly under appropriate treatment; but it may assume a more severe form and spread through the tissues of the stump, leading to gangrene.

(3) *Hæmorrhage.*—If the means for effecting hæmostasis have been inadequate, hæmorrhage may continue after the completion of the operation. Although bleeding may have ceased apparently before the sutures are introduced, oozing more or less profuse may occur as the result of the vasomotor paralysis which succeeds the anæmia of the limb brought about by the tourniquet.

Secondary hæmorrhage is seldom observed now as a complication following amputations. Its occurrence would be favoured by sepsis in the wound, leading to softness of the arterial coats at the seat of ligature and disintegration of the thrombus within the vessel.

(4) *Osteitis and Osteomyelitis.*—Infection of the bone at the plane of section may result in necrosis of varying extent. If the amount of bone involved is slight and limited to the affected extremity, the necrotic portion, consisting of a central ring-like sequestrum, may be detached after a tedious course of suppuration. If, on the other hand, the osteomyelitis assumes a spreading form, so as to involve a considerable extent of the bone, a second amputation may be necessary.

AMPUTATIONS OF THE FINGERS.

Indications.—The following are the principal conditions which require amputations of the fingers: (1) Trauma, viz., severe crushes, machinery accidents, etc.; (2) tuberculous dactylitis; (3) certain forms of new growth (enchondroma); (4) ankylosis following arthritis, as a result of which the finger is stiff and rigid and an encumbrance to the individual; (5) a supernumerary digit.

Sites for Amputation.—What may be termed the typical amputations of the fingers are performed at the following sites: (1) The proximal or distal interphalangeal joints; (2) through the first or second phalanx; (3) at the metacarpo-phalangeal articulations.

Although these are the usual sites for amputations, yet in view of the great importance of preserving as much of the digits as possible the surgeon will be guided by the conditions of each case: thus, after severe crushes of one or more fingers, the amputation often consists in trimming the stumps which remain, utilising all available tissue to the greatest advantage.

Instruments.—The instruments usually employed in amputations have been enumerated. The form of knife which is most satisfactory in the case of the fingers is one with a long slender blade resembling a straight, sharp-pointed bistoury. A tourniquet is not required in these amputations. The arteries which are divided are of small size, and are easily secured by clip forceps.

Amputation through the Distal Inter-phalangeal Joint.—The hand and forearm are held by an assistant, who, at the same time, draws aside the remaining fingers and keeps them out of the way. The surgeon grasps the phalanx to be removed with his left thumb and index finger and flexes the joint (Fig. 1).

The knife is drawn across the joint on its dorsal aspect with a sawing motion from left to right, the line of incision presenting a slight forward convexity. The joint is fully opened by dividing the lateral ligament on each side, and the expansion of the extensor tendon on the dorsum.

While the joint is maintained fully flexed the knife is made to divide the glenoid ligament and the deep flexor tendon, close to the palmar margin of the distal phalanx. Its cutting edge is then directed towards the finger-tip cutting close to the bone and in the direction of its long axis. Having reached a point near the free border of the nail, the edge of the knife is directed towards the skin, and is made to cut abruptly through the intervening tissues.

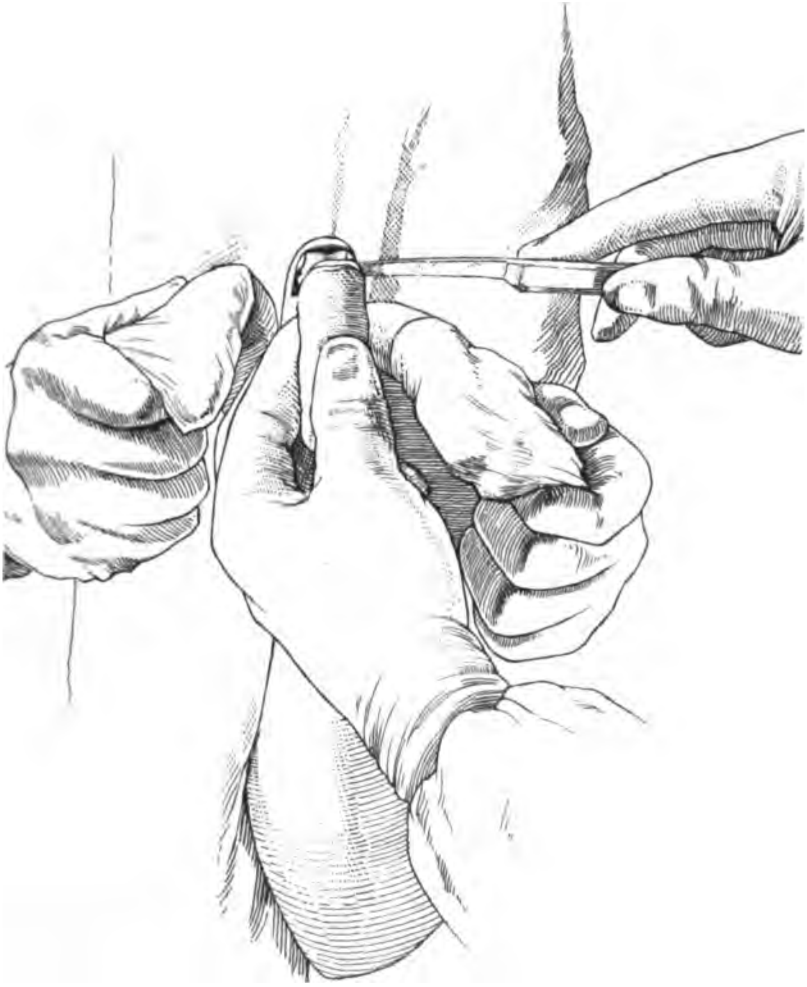

FIG. 1.—Disarticulation at the proximal inter-phalangeal joint. (E. H. T.)

The flap thus raised from the palmar aspect of the finger is amply nourished. It is well endowed with sensibility and is admirably adapted to withstand pressure. It is adjusted over the head of the middle phalanx and retained in position by a few sutures of silkworm gut. The cicatrix is placed well towards the dorsal aspect of the stump.

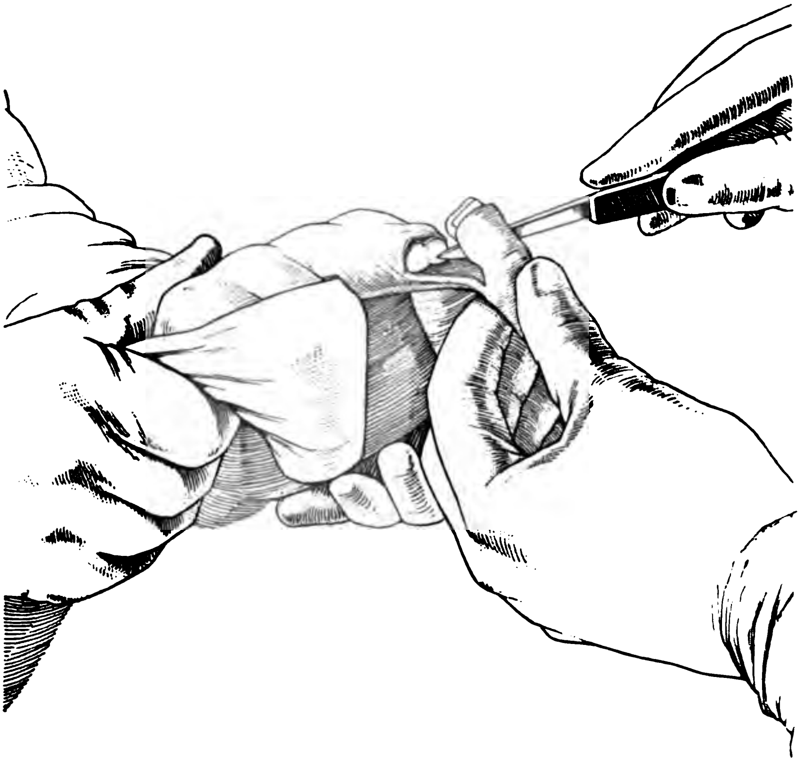

FIG. 2.—Disarticulation at the proximal inter-phalangeal joint. Cutting the palmar flap. (E. H. T.)

The finger is enveloped in a suitable dressing, and is immobilised on a palmar splint, which extends upwards beyond the wrist.

Amputation through the Middle Phalanx.—The plan of amputation resembles the preceding, in that a long palmar flap is raised, capable of covering the end of the divided bone. In length the flap varies from $\frac{3}{4}$ to 1 inch. It is cut from without inwards, and contains all the tissues in relation to the palmar aspect of the bone; it is almost rectangular in shape.

The dorsal incision is transverse and connects the two extremities of the palmar incision. When the palmar flap has been reflected the bone is cleared and divided at the level of the dorsal incision.

When the amputation is through the middle phalanx the lateral attachments of the corresponding superficial flexor tendon will probably be preserved, and will help to flex the segment of the finger that remains.

If the bone is divided above its mid-point it will be advisable to secure the two flexor tendons in the palmar flap, and suture them either to the margin of their sheath, or to the extensor tendon on the dorsum in order to provide the stump with an adequate degree of mobility.

Disarticulation at the Proximal Inter-phalangeal Joint is performed exactly as described in the case of the distal inter-phalangeal joint, and an amputation through the proximal phalanx resembles that just described. In both cases the two flexor tendons are divided, and as they lie loose within their fibrous sheath they tend to retract towards the palm, with the result that the segment of the finger which is left will lose its power of flexion unless the flexor tendons are secured by sutures to the divided margin of the sheath. In carrying out this step one or two sutures of fine catgut are passed through the theca, the flexor tendons, and the glenoid ligament. They anchor the tendons, and at the same time they securely close the sheath; this is a useful precaution if there is reason to be apprehensive of septic infection subsequently in the wound.

If the amputation is performed through the proximal phalanx the same procedure is adopted for securing the flexor tendons and closing the sheath.

Disarticulation at the Metacarpo-phalangeal Articulations.—Disarticulations at these joints are usually performed through racket-shaped incisions. In the case of the middle and ring fingers the resulting cicatrix is terminal, but owing to its concealed position this does not result in any disadvantage. When the other digits are concerned a terminal cicatrix must be avoided.

Disarticulation by a Racket Incision.—In disarticulating by a racket incision the tissues investing the finger are divided circularly or with a slight degree of obliquity at the level of the free margin of the interdigital web, and from this incision another is carried vertically upwards in the mid-dorsal line over the knuckle as far as the neck of the metacarpal bone. The tissues overlying the knuckle are reflected, the remaining peri-articular structures are divided and disarticulation effected. The wound margins meet over the head of the metacarpal bone, and the resulting cicatrix lies between the remaining digits and is well protected from pressure.

The Steps of the Operation.—The respective attitudes of the surgeon and his assistants are the same as for disarticulations through the inter-phalangeal joints (Fig. 5).

The surgeon, holding the finger in the extended position in his left hand, divides the skin circularly or with a slight obliquity at the level of the inter-digital web. This step is most readily executed by three successive cuts. One of these is made on each lateral aspect of the finger by drawing the blade of the bistoury from heel to point. These incisions meet on the dorsum of the finger, and from their junction a vertical cut is carried back to the level of the neck of the metacarpal bone. A third incision is made transversely or in the form of a V on the palmar aspect of the finger by over-extending it and connecting the extremities of the two incisions

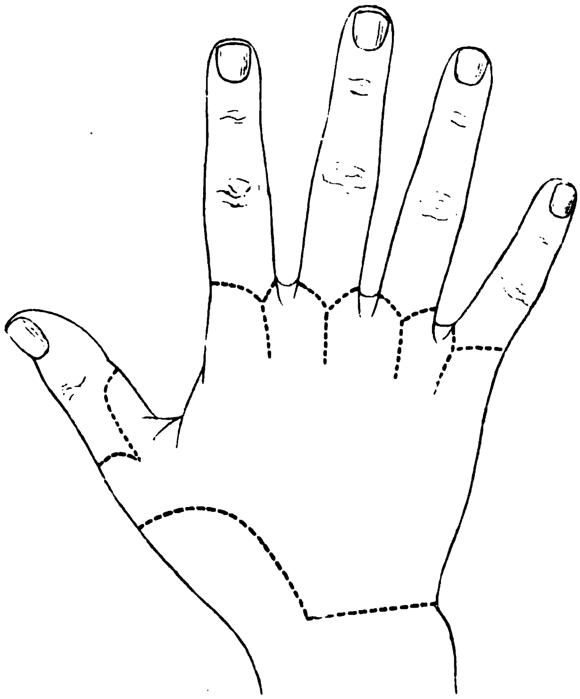

FIG. 3.—Lines of incision for disarticulations at the metacarpo-phalangeal articulations of the fingers and thumb and at the wrist joint. Viewed from the dorsal aspect of the hand.

already made in the crease which marks the junction of the finger with the palm (Fig. 5).

The tissues on the dorsal and lateral aspects of the knuckle are dissected up and held aside by clip forceps, and the extensor tendon is divided.

While the finger is held in the extended position the incision is carried more deeply on each side of the joint dividing the digital vessels and the tendons of the lumbrical and interossei muscles.

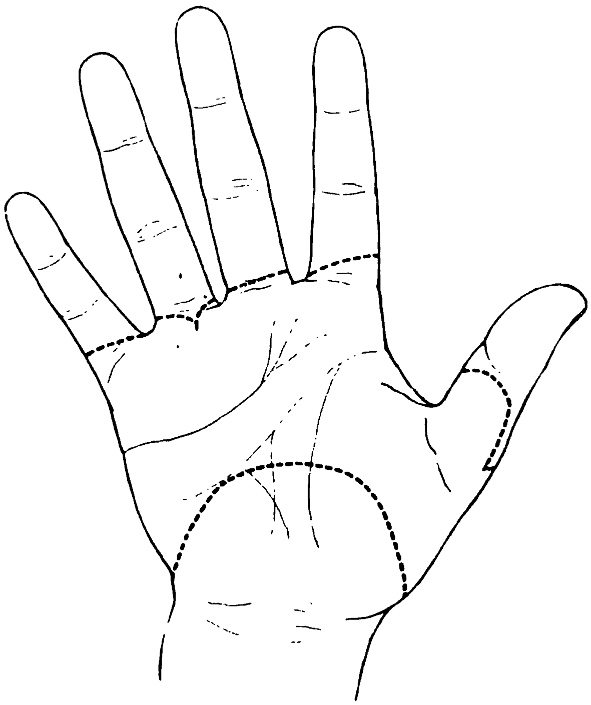

FIG. 4.—Lines of incision for disarticulations at the metacarpo-phalangeal articulations of the fingers and thumb and at the wrist joint. Viewed from the palmar aspect of the hand.

The finger is now hyperextended, and the incision on its palmar aspect is carried through the flexor tendons and the glenoid ligament opening the joint.

By a twisting movement transmitted to the finger the tissues which still retain it are brought successively into view, whereupon they are divided and the disarticulation completed.

The digital arteries are secured by forceps, but should they continue to bleed when these are removed, they may be twisted or controlled by silkworm gut sutures which bring the wound margins together.

The adjustment of the wound is facilitated by seizing its proximal and distal extremities with clip forceps and drawing these apart. By this manœuvre the cutaneous margins are approximated over

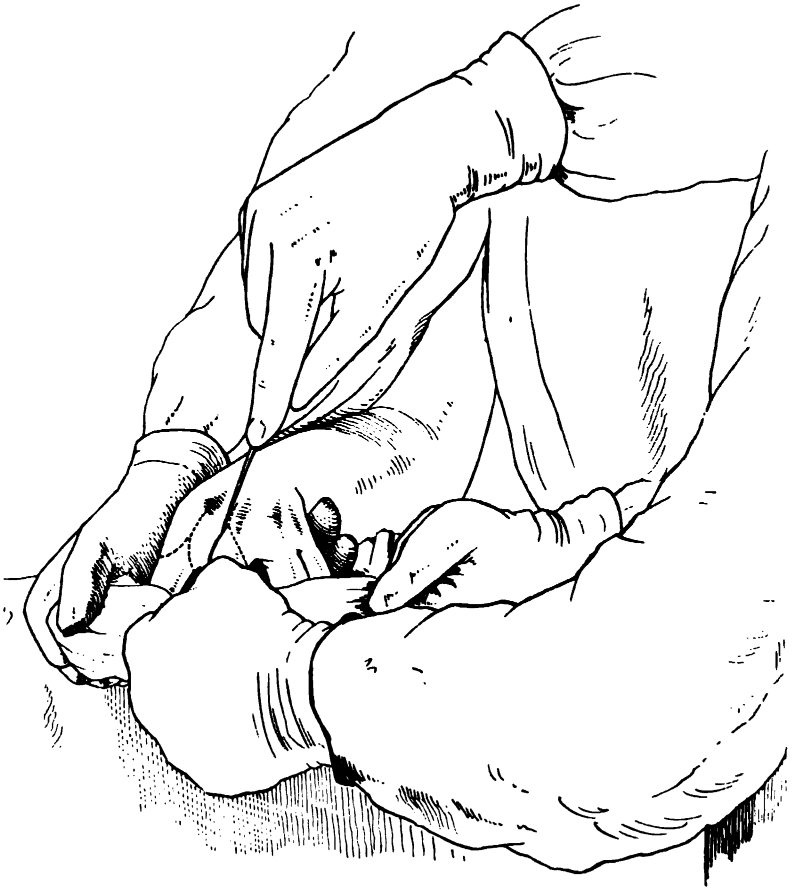

FIG. 5.—Disarticulation at the metacarpo-phalangeal joint of the middle finger by a racket-shaped incision. (E. H. T.)

the head of the metacarpal bone and the introduction of the sutures can be carried out with ease and precision.

Excision of the Head of the Metacarpal Bone is sometimes performed for the sake of appearance, but it has the disadvantage of weakening the power of the hand for grasping and therefore will diminish its functional capacity. If it is decided to carry out this step, the portion of the incision corresponding to the head of the racket is made with a more decided obliquity, and the vertical portion of the incision is carried back further over the middle of the metacarpal bone. When either the third or fourth metacarpal bone is concerned the tissues are reflected from the joint without disarticulating as far as the neck of the metacarpal bone, at which level the section is made with a sloping direction from above downwards and forwards.

Amputation at the Metacarpo-phalangeal Articulation of the Index Finger.—This is carried out by a procedure similar to the above, with a slight modification which has for its object the placing of the cicatrix well towards the ulnar side of the metacarpal bone, so that it may not be exposed to pressure subsequently.

The racket incision is made by three successive cuts. The first of these crosses the radial border of the finger obliquely, a little below the level of the web between it and the third finger (Fig. 5). Having reached the dorsum of the finger it crosses the extensor tendon, and is carried back along the ulnar side of the head and neck of the metacarpal bone.

The second incision crosses the ulnar border of the finger obliquely at the level of the web, and quickly joins the first at the ulnar side of the extensor tendon (Fig. 5).

The third incision connects these two and crosses the palmar aspect of the finger with a slight obliquity. The tissues are raised, the extensor tendon is divided and disarticulation effected by opening the joint on the ulnar side, the finger being fully abducted meanwhile. As the head of the index metacarpal bone would form an unsightly projection if left behind, it had better be removed. This is done by an oblique section which runs from without inwards, so that more of the bone is removed from its radial than from its ulnar border.

Amputation at the Metacarpo-phalangeal Joint of the Little Finger is carried out by a procedure very similar to that just described. The racket incision is made in such a way that the resulting cicatrix will lie well over against the fourth metacarpal bone, away from the ulnar border of the hand. The incision forming the handle of the racket, instead of overlying the fifth metacarpal bone, is situated over the fourth interosseous space. The head of the metacarpal bone is removed by an oblique cut, the line of section running from within downwards and outwards.

Amputation at the Metacarpo-phalangeal Joint of the Thumb may be performed by a long palmar flap consisting of the tissues beneath the first phalanx. The palmar incision crosses the thumb at or near the inter-phalangeal joint; the dorsal incision is just below the metacarpo-phalangeal joint. The superficial tissues are most easily divided by four separate cuts, one on each side in the mid-lateral line of the thumb from the level of the metacarpo-phalangeal joint to just beyond the inter-phalangeal flexure. Of the two remaining incisions one curves across the thumb on its palmar aspect opposite the inter-phalangeal joint; the other crosses the dorsum immediately below the joint line. The palmar flap is dissected up, the flexor sheath opened and its contained tendon divided. The joint is reached by cutting through the glenoid ligament. The remaining tissues are most easily divided by twisting the thumb from side to side and bringing them successively into view. The palmar flap overlies the head of the metacarpal bone, and the cicatrix will not be exposed to pressure.

Amputation of the Thumb with its Metacarpal Bone is seldom performed in the living subject as it is of great importance that as much of the metacarpal bone as possible should be preserved with a view to the future utility of the hand.

The disarticulation is performed through an oblique racket incision made by three successive strokes of the knife, the thumb being fully abducted meanwhile. The lateral incisions cross the respective borders of the digit obliquely at the level of the interdigital web, and meet on the dorsum of the metacarpal bone well behind the metacarpo-phalangeal joint line. The palmar portion of the incision follows the crease between the thumb and the fleshy mass of the thenar eminence—opposition crease. The posterior extremity of that part of the incision which corresponds to the handle of the racket is inclined to the radial border of the hand over the tendon of the extensor ossis metacarpi pollicis muscle, and in the same vertical line as the tip of the radial styloid, so as to avoid wounding the radial artery as it crosses the back of the wrist to the posterior part of the first interosseous space. The superficial tissues over the metacarpal bone are divided and turned aside; the tendons of the extensor muscle are also divided. The metacarpal bone is then hyper-extended and the muscles attached to it on its palmar aspect are divided. The joint having been reached, the ligaments are divided and the metacarpal bone twisted from side to side as its attachments are dealt with, and at the same time the knife is manipulated with care so as to avoid the radial artery.

Amputation of a Finger with its Metacarpal Bone may also be performed through a racket incision, but is seldom required except in the case of the little finger. In carrying out the procedure for this digit the incision which corresponds to the handle of the racket extends from just behind the base almost to the level of the neck of the metacarpal bone on its dorsal aspect. The remainder of the incision constituting the head of the racket is made by three strokes of the knife: one from the ulnar border of the finger just behind the level of the web back to join the dorsal incision; one from the radial border to join the dorsal incision; while a third crosses the finger on its palmar aspect connecting these two incisions. While the hand is held steady by an assistant the tissues are dissected up from the metacarpal bone on its ulnar aspect. The flexor tendons are divided beneath, and the transverse ligament and the interossei muscles are detached from the bone along its radial border. Disarticulation is effected by dividing the dorsal ligaments at the carpo-metacarpal joint, then by abducting and twisting the finger its remaining attachments are exposed and divided. If difficulty is encountered in freeing the base of the bone, the superficial tissues may be divided by a short transverse incision at the extremity of the vertical cut. The wound margins are adjusted in the usual way by interrupted sutures of silkworm gut, and the cicatrix will be found to lie well away from the ulnar border of the hand.

This operation is rarely required for the other digits. Instead of disarticulating those, the affected metacarpal bone may be divided near its basal extremity. By not encroaching on the joint the deep palmar arch is not exposed to injury and the general synovial cavity of the wrist will not be opened.

DISARTICULATION AT THE WRIST-JOINT.

Disarticulation at the wrist is seldom required. It may be indicated, however, in any of the following conditions: (1) Certain cases of tuberculous disease involving the carpus, but the extent of the local infiltration, involving, as it so frequently does, the articulations of the wrist and carpus and the surrounding tendon sheaths, usually renders it necessary to amputate at a higher level; (2) severe trauma; (3) certain cases of malignant disease involving the hand; (4) disabling contraction and distortion of the hand following burns or septic conditions.

Disarticulation by an Elliptical Incision.—In this operation a flap is fashioned from the tissues of the palm, and when disarticulation is effected it is folded back so as to cover the articular surface of the radius and the triangular fibro-cartilage.

The highest point of the ellipse is at the back of the wrist about ½ inch on the distal side of the joint line; its lowest part crosses the palm just above the level of an imaginary transverse line at the lower border of the outstretched thumb (Fig. 4).

The limb is elevated for a few minutes and a tourniquet is applied to the arm a couple of inches above the condyles of the humerus.

An assistant holds the limb, and the elliptical incision is made while the surgeon holds the part to be removed in his left hand. The curve on the dorsum presents a concavity towards the fingers and is made with the hand in pronation; it meets the radial border of the wrist opposite the base of the first metacarpal bone and the ulnar border at the corresponding part of the fifth metacarpal bone. The superficial tissues are divided.

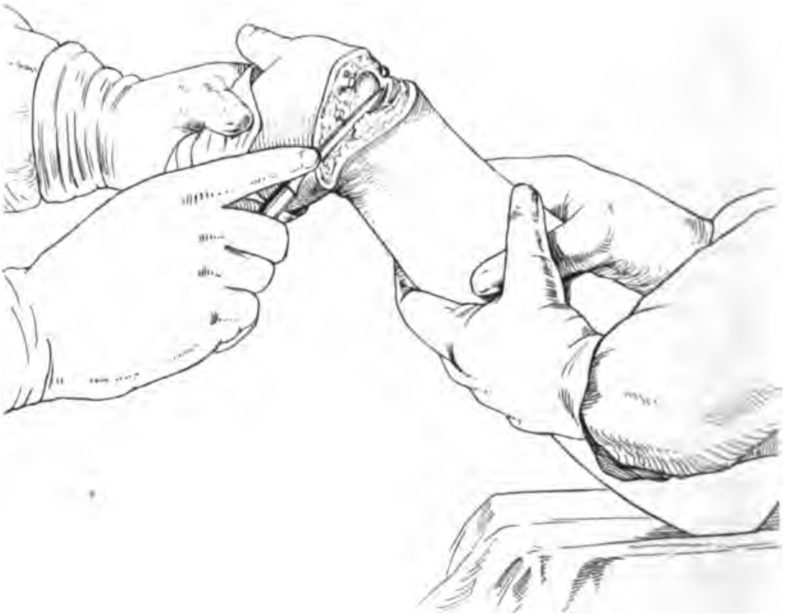

FIG. 6.—Disarticulation at the wrist joint. (E. H. T.)

The palmar portion of the ellipse marks out a broadly rounded flap; it is made with the hand supine and connects the extremities of the dorsal incision. It is deepened on each side by a free division of the short muscles of the thumb and little finger, and is carried through the palmar fascia into the median compartment of the palm.

Disarticulation is performed by the surgeon turning the hand so that its radial border is uppermost, and dividing the tendons and the external lateral ligament immediately below the styloid process of the radius (Fig. 6). The extensor tendons and the posterior ligaments on the back of the wrist are next divided, and the joint fully opened from its dorsal aspect, the hand being strongly flexed meanwhile. The anterior ligament of the wrist is next divided, and the section is carried through the flexor tendons and made to emerge through the incision already traced in the palm.

The pisiform bone, which is usually detached with the tissues of the palmar flap, is caught with forceps and dissected out.

The ulnar and radial arteries are secured and ligatured. The median nerve is identified in the midst of the divided flexor tendons; it is drawn out and cut short.

The palmar flap is folded back and adjusted by interrupted sutures of silkworm gut; a dressing is applied with moderate pressure and the limb placed in a sling.

This operation provides an excellent flap which affords thick covering to the ends of the bones. This flap consists of tissues which are accustomed to pressure and possessing a good blood-supply. The cicatrix is situated dorsally and is well removed from pressure.

Disarticulation by Means of an External Flap (Dubreuil).—In this procedure a flap is raised consisting of the tissues investing the first metacarpal bone, and when disarticulation has been effected it is laid across the articular surface of the radius and the triangular fibro-cartilage.

The tourniquet is applied as in the previous amputation. The incision is commenced on the dorsal aspect of the wrist of the junction of its middle and outer thirds, ½ inch below the joint level. It is carried down over the first interosseous space, across the dorsum of the first metacarpal bone below its middle, and from thence is prolonged upwards over the thenar eminence to a point on the front of the wrist exactly opposite to where the incision commenced behind (Fig. 3).

The superficial tissues overlying the inner segment of the wrist are divided in circular fashion, the incision connecting the extremities of the base of the thenar flap. This latter is dissected up to its base, and in doing so as much of the muscular tissue of the thumb as possible is raised too.

The joint is opened as in the disarticulation by the elliptical incision, viz., by dividing the external lateral ligament immediately below the radial styloid, and the disarticulation is completed by dividing the dorsal, internal lateral and anterior ligaments.

The ulnar and radial arteries are ligatured, and the flap is adjusted by means of interrupted sutures of silkworm gut.

Disarticulation by a Circular Incision.—The tourniquet is applied as before. The surgeon, standing to the right of the affected limb, draws up the tissues of the wrist with his left hand and marks out a circular incision extending around the wrist about 1 inch below the tip of the radial styloid process. As the superficial tissues are divided the retraction of the skin will take place to the required extent, viz., to the level of the tips of the radial and ulnar styloid processes.

Commencing at the radial side the external lateral ligament is divided, and then in order the extensor tendons and dorsal ligaments and the internal lateral ligament. The joint is now fully flexed so as to gain access to the flexor tendons contained within the carpal tunnel. These are fully exposed and divided, and the median nerve which lies between them is drawn down and a portion of it removed.

The radial and ulnar arteries are ligatured.

The wound margins are brought together in a transverse direction, and it will probably be advisable to introduce a small glass drainage tube for twenty-four hours.

AMPUTATION THROUGH THE FOREARM.

The principal indications for amputation through the forearm are :

(1) Tuberculous disease of the hand and wrist.

(2) Severe injuries in which the bones of the hand and wrist are crushed and the soft tissues badly mangled.

(3) Malignant disease of the hand.

(4) Certain acute septic conditions of the hand and wrist.

(5) Some forms of sarcoma implicating the lower extremities of the radius or ulna.

As much of the forearm should be preserved as possible so as to provide a stump which will afford good leverage to the artificial limb. The term "seat of election" in amputation through the forearm has been employed to indicate a point just below the insertion of the pronator radii teres muscle, opposite the centre of the outer border of the radial shaft.

The Modified Circular Amputation is the one most generally applicable to the forearm; it is performed by means of two equal antero-posterior flaps.

Hæmorrhage is controlled by an Esmarch's tourniquet applied to the middle of the upper arm. The surgeon stands at the right side of the limb, which is supinated and abducted at a right angle to the trunk. It may be held by an assistant or supported by a special arm-rest connected with the operating table (Fig. 7).

Each flap is about 1 inch longer than half the antero-posterior diameter of the forearm at the level of the bone section, and its width is equal to half the circumference of the limb at the same level. The antero-posterior diameter is most easily estimated by spanning the limb with the thumb and index finger.

The flaps are marked out by making two vertical incisions, one along each lateral margin of the limb, and then connecting these in front and behind by two curved incisions. The anterior incision is made with the limb abducted and supine, the posterior while the forearm is raised with its posterior aspect facing the operator (Fig. 8).

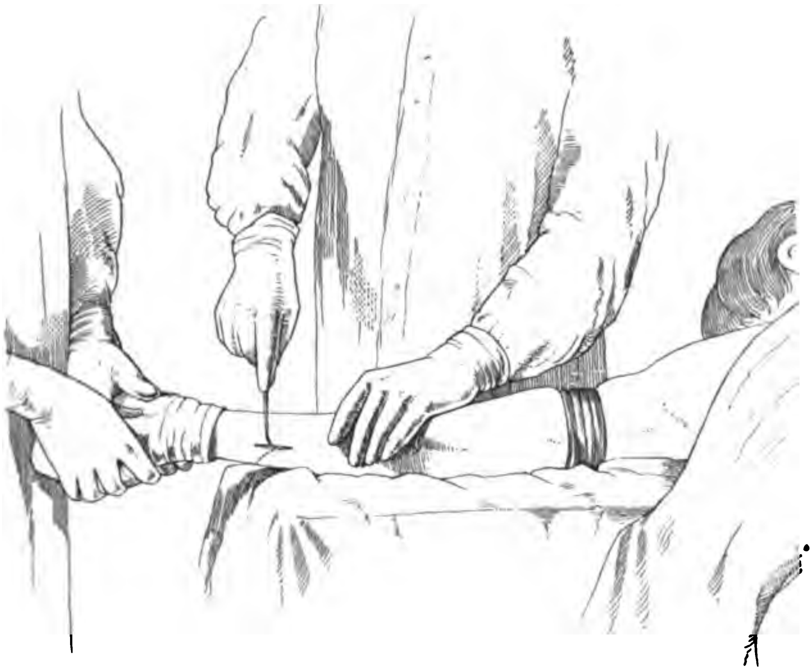

FIG. 7.—Amputation through the forearm by the modified circular method. (E. H. T.)

The two cutaneo-fascial flaps are dissected up to their bases, and in doing so the cutting edge of the knife is directed towards the deep fascia. The muscles are next divided circularly about 1 inch below the proposed line of bone section. The division of the muscles may either be made straight to the bones, or the muscular masses in front and behind may be cut by transfixion, the knife being introduced flat-wise against the bones and then turned abruptly with its cutting edge directed towards the surface. This latter method is well suited for dividing the tendons below the centre of the forearm.

The muscles are gently pushed aside so as to expose the bones at the required level and the interosseous membrane is divided.

The soft tissues are drawn aside with a three-tailed linen retractor, the middle strip of which passes between the bones and the lateral in relation to the respective borders of the limb (Fig. 9). As the bones are being divided the forearm is held supine and the cut is commenced in the radius; it is then carried into the ulna, but the radial section is completed before that of the ulna as the radius is less securely connected with the humerus than the latter bone.

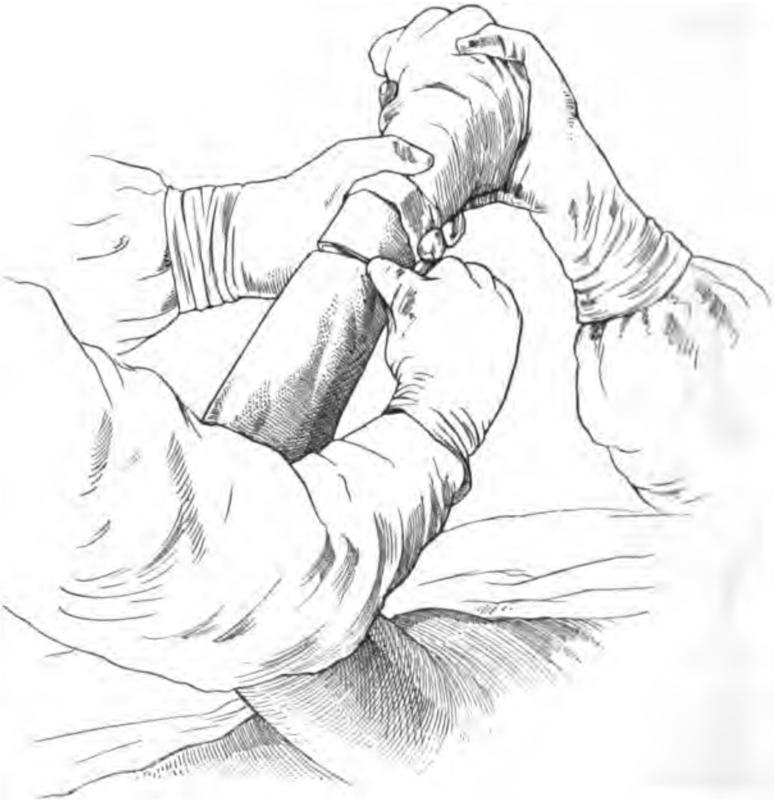

FIG. 8.—Amputation through the forearm by the modified circular method. Marking out the posterior flap. (E. H. T.)

The ulnar, radial and anterior interosseous arteries are secured and ligatured. The median, radial and ulnar nerves are successively seized, drawn down and cut short.

The tourniquet is relaxed, and any obvious vessel that bleeds is ligatured or twisted.

The flaps are brought together at their mid-points by a silkworm gut suture, and the cutaneous margins are approximated by a continuous suture of fine thread, a space being left at one angle for a drainage tube.

The stump is placed on a splint in the supine position in order that the interosseous interval may be maintained as wide as possible. It may be more convenient, however, to allow the stump to assume the mid-prone position.

Circular Amputation through the Forearm.—This may be performed in the lower third of the forearm where its contour is approximately cylindrical, but not higher up where the limb becomes conical.

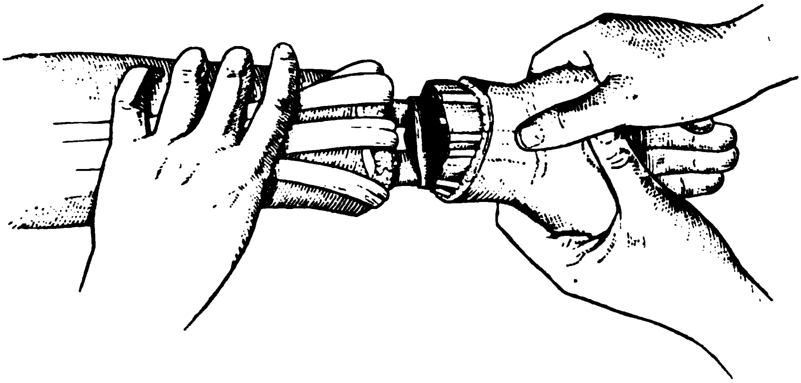

FIG. 9.—Amputation through the forearm by the modified circular method. The three-tailed retractor in position preparatory to sawing the bones. (E. H. T.)

The tourniquet is applied and the limb is placed in the same position as in the last operation.

A circular incision is carried round the forearm at a distance below the proposed line of bone section equal to about two-thirds the antero-posterior diameter of the limb at that level. The superficial tissues are divided and retracted from the muscles by a few light strokes of the knife, the limb being suitably manipulated meanwhile. In this way a skin cuff is raised, its base reaching to within 1 inch of the level selected for the bone section.

The muscles and their tendons are divided opposite the base of the skin cuff by transfixion. The bones are exposed and the interosseous membrane divided. A three-tailed retractor, introduced as in the last operation, draws the tissues aside and prepares the way for the saw cut.

The bones are divided as before, the same precautions being employed with reference to the division of the radius.

The radial, ulnar and anterior interosseous arteries are ligatured, the nerves are cut short, and any tendons which protrude are suitably trimmed.

The flaps are connected by one or two sutures of silkworm gut and the cutaneous margins are approximated by a continuous suture of fine thread. A small drainage tube is introduced at one lateral angle.

In this amputation, as in the one preceding, it will be observed that the cicatrix is terminal, but this circumstance is not attended by any disadvantage as the pressure of the artificial limb is brought to bear against the front of the forearm and not against its divided extremity.

DISARTICULATION AT THE ELBOW-JOINT.

This operation is but seldom required. It may be indicated, however, for severe injuries of the forearm; sarcomata involving the radius or ulna, epitheliomata of the hand or forearm, or extensive disease or necrosis of the radius and ulna.

Disarticulation by an Anterior Elliptical Incision.—In this operation the covering for the stump is obtained from the tissues on the front of the upper part of the forearm. The highest point of the ellipse lies over the tip of the olecranon posteriorly; the lowest anteriorly, a hand's breadth below the level of the joint.

The surgeon stands at the left side of the limb which is abducted from the side so as to be able to grasp and manipulate the forearm with his left hand.

The circulation is controlled by a tourniquet applied above the centre of the arm.

The forearm being slightly flexed and rotated towards the surgeon, he enters the knife posteriorly over the olecranon and cuts downwards and forwards around the lateral aspect of the limb furthest from him to the lowest point of the ellipse. The incision is then continued upwards around the opposite border of the limb, and backwards to the olecranon so as to complete the ellipse. The superficial tissues are divided and allowed to retract.

The muscular tissues in front of the bones are divided from before backwards and upwards in an oblique plane, so that when the large anterior flap is raised the contained muscle tissue will consist of a wedge-shaped mass, wide above and tapering below.

The front of the joint having been exposed, the ligaments are divided, commencing at the radio-humeral articulation on the outer side and continuing across to the inner side. The forearm is now forcibly hyper-extended and the upper extremities of the radius and ulna are dislocated forwards. The incision is finally carried backwards through the posterior ligament and the insertion of the triceps tendon at the summit of the olecranon.

The radial, ulnar and interosseous arteries which lie in the anterior flap and the inferior profunda artery behind the internal condyle are secured by ligature.

The median, ulnar and radial nerves are isolated and cut short.

The large flap is folded back over the lower extremity of the humerus and connected with the wound margin posteriorly by a few interrupted sutures of silkworm gut, the skin edges being adjusted by means of a continuous suture of fine thread or by metallic clips. A small drainage tube is inserted and removed after twenty-four or forty-eight hours.

This method of disarticulating at the elbow affords a good muscular pad, with a plentiful blood-supply to cover the lower extremity of the humerus. It is an expensive method, however, as it requires a large amount of healthy tissue to be reflected from the anterior aspect of the forearm, and in some cases this may not be available.

Disarticulation by a Racket Incision.—The rounded portion of the racket crosses the dorsal aspect of the forearm transversely, a hand's breadth below the summit of the olecranon. It curves around the lateral margins of the limb to the front, where its two limbs unite about 1 inch below the bend of the elbow.

The tourniquet is applied above the middle of the arm.

The surgeon stands as in the last operation, facing the fully abducted arm and somewhat to the left side, so as to be able to hold and manipulate the forearm (Fig. 10).

The incision representing the racket is made by three successive strokes of the knife. Commencing at the border of the limb furthest from the surgeon the cutting edge of the knife is laid against the skin and made to cut in a curved direction towards the centre of the limb and upwards to the middle of the flexure of the elbow. A similar incision is made from a corresponding point on the opposite border of the limb, curving to the centre of the limb, where it joins the first incision. The racket is completed by connecting these two incisions across the back of the forearm (Fig. 10).

The supinator and extensor mass of muscles on the outer side, and the pronator and flexor mass on the inner side are raised and reflected until the anterior aspect of the joint capsule is exposed. The surgeon then, holding the forearm in his left hand and facing the joint, divides the ligaments, commencing just above the rounded head of the radius.

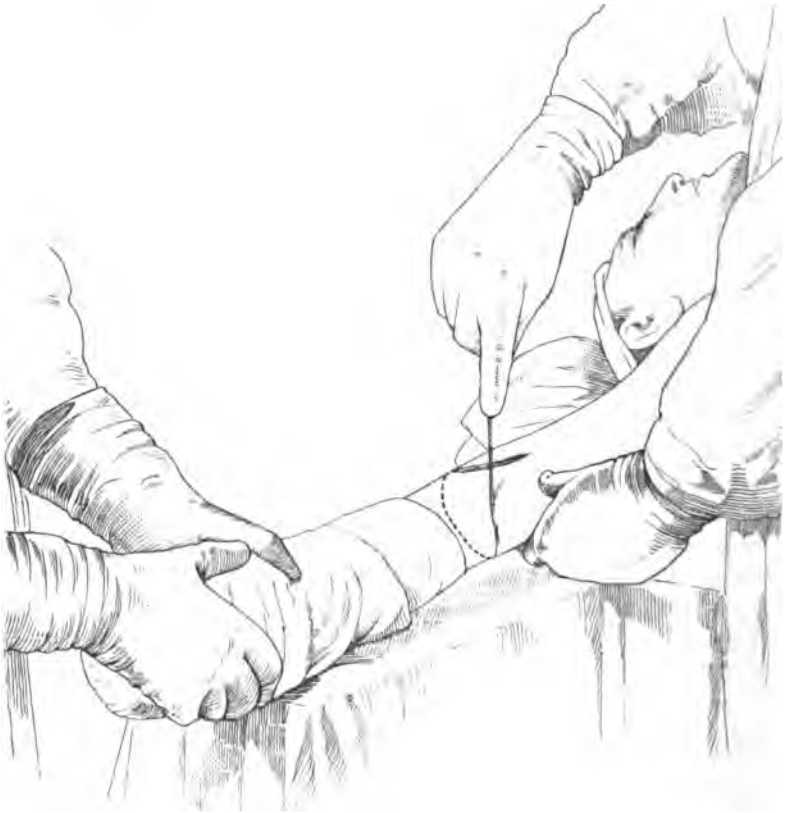

FIG. 10.—Disarticulation at the elbow-joint by a racket incision. (E. H. T.)

By forcibly hyper-extending the forearm the radius and ulna are dislocated forwards, whereupon the posterior ligament of the elbow-joint is divided and the tendon of the triceps is detached from the olecranon. By drawing the forearm well forwards the tissues can be readily detached posteriorly until the knife emerges through the transverse part of the incision below (Fig. 11).

The blood vessels are secured by ligature as before, and the nerves are cut short.

The wound margins are united in the longitudinal direction so as to leave an anterior linear cicatrix, which, in the course of time, shrinks to very small dimensions.

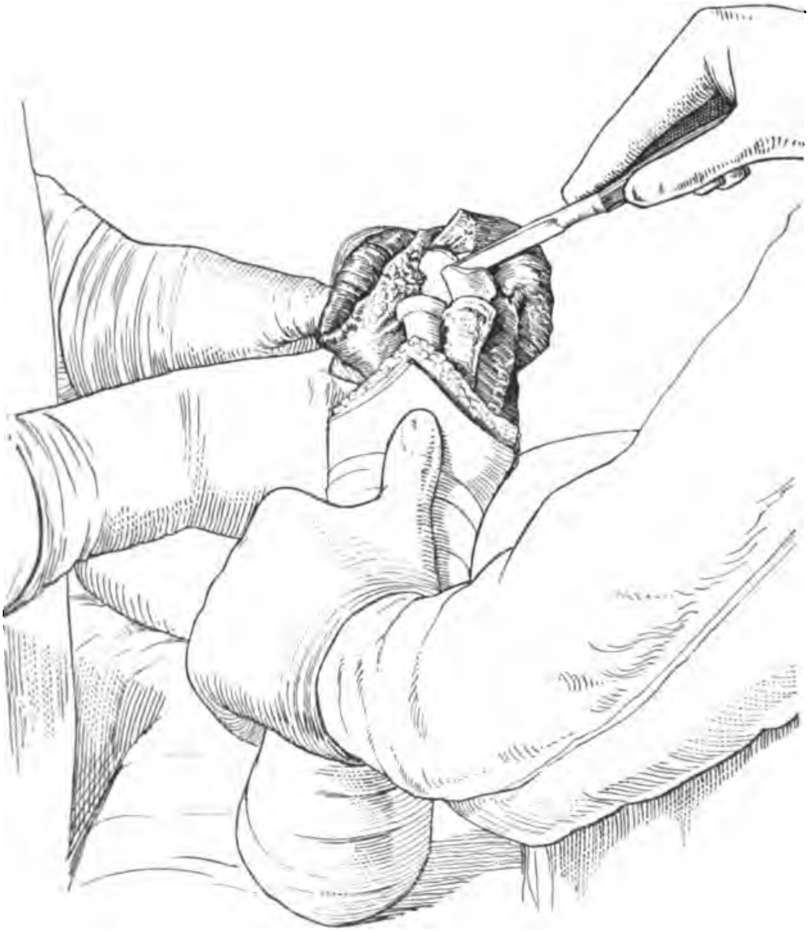

FIG. 11.—Disarticulation at the elbow-joint by a racket incision. (E. H. T.)

Disarticulation by a Circular Incision.—The tourniquet is applied as before. With the forearm fully extended and supinated the superficial tissues are divided by a circular incision four fingers breadth below the summit of the olecranon.

The cuff of skin and subcutaneous tissue is reflected to a slight extent before dividing the muscles circularly below the level of the joint.

The muscles are detached subperiosteally from the upper extremities of the radius and ulna until the ligaments of the elbow-joint are exposed. These are divided, commencing at the outer side and carrying the section inwards.

The forearm bones are forcibly dislocated forwards. The posterior ligament of the elbow and the triceps tendon are detached from the olecranon and the tissues are dissected away until the knife emerges through the posterior part of the circular incision.

The vessels are secured as before and the nerves are cut short. The wound is sutured transversely.

This disarticulation by means of a circular incision comes to resemble one by a posterior elliptical incision. In full extension the skin on the flexor aspect of the upper part of the forearm is tightly stretched, but posteriorly it is relaxed. In consequence of this inequality of tension when a circular incision is made, retraction occurs to a much greater extent in front than behind, so that the original incision assumes the form of a posterior ellipse, and when the wound margins are brought together transversely the cicatrix lies in front of the lower extremity of the humerus.

This method of disarticulating makes less demands upon the tissues of the forearm than the majority of other operations at this level and has therefore a wide range of applicability. The resulting stump is extremely good.

AMPUTATION THROUGH THE ARM.

Indications.—Amputation at this level is indicated mainly for severe injuries to the forearm and elbow, certain cases of sarcoma of the radius or ulna, extensive tuberculous disease or suppurative arthritis of the elbow-joint, some cases of acute cellulitis involving the forearm and accompanied by severe toxæmia or symptoms indicative of septicæmia.

Hæmostasis.—The circulation may be controlled by a tourniquet at the upper part of the arm, or digital compression of the axillary artery may be attempted when the amputation is performed near the elbow. For amputations at a higher level the tourniquet is made to pass over a firm pad in the axilla, its two ends are then crossed over the shoulder in a figure-of-eight manner and are secured at the level of the axilla upon the opposite side. The difficulty of retaining a tourniquet close to the shoulder may be overcome by employing long metal pins or skewers which transfix the tissues at the inner and outer sides of the limb, and applying the tourniquet above them (Wyeth). A convenient method for controlling hæmorrhage is to expose and ligature the brachial artery before its division after the cutaneous incisions have been made.

The Modified Circular Amputation.—The site selected for the amputation should be as low as possible, as the fitting of an artificial appliance is greatly facilitated by a stump of good length.

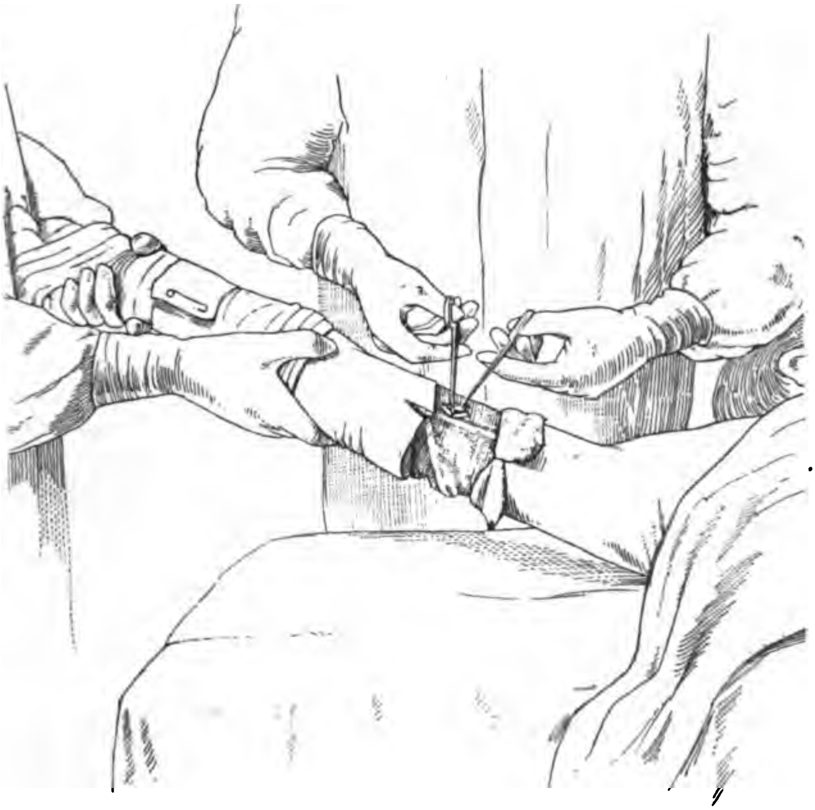

FIG. 12.—Amputation through the arm by the modified circular method. The superficial flaps have been reflected and the brachial artery has been secured preparatory to ligature. (E. H. T.)

In the modified circular amputation two equal antero-posterior flaps are raised, consisting of the superficial tissues, and the muscular strata are divided circularly at the level of the bases of the retracted flaps.

In all amputations through the arm and shoulder the patient is placed near the edge of the table, the shoulder projecting slightly over it, and the limb is abducted at right angles by an assistant, who manipulates it under the direction of the surgeon as the amputation proceeds.

The surgeon stands upon the right side of the limb, with his chief assistant opposite.

The Amputation.—The level of the bone section having been determined, the surgeon proceeds to gauge the extent of the flaps. These are each equal in breadth to half the circumference of the limb, and in length each should measure before section two-thirds of the antero-posterior diameter of the limb where the bone is sawn. In fashioning these flaps a useful procedure is to first make a vertical incision on each side of the limb, and then to connect these by two curved incisions, crossing the anterior and posterior aspects of the limb (Fig. 12).

The flaps are dissected up to their bases and carefully retracted. The muscular section is then effected. The first cut is made circularly through the muscles half-way between the lower level of the skin incision and the bases of the flaps, but does not extend through their entire thickness. The cut muscular tissues are freely retracted and another circular cut made as high as the retracted muscles will allow. By still further retracting the muscles the final section is made at the level of the bone section, and the periosteum is divided circularly also.

The flaps and divided muscles are protected and drawn up out of the way by means of a two-tailed linen retractor, and the humerus is divided.

The brachial artery and its profunda branches are secured and ligatured with catgut.

The median, ulnar and musculo-spiral nerves are seized, drawn down and cut short. Owing to its intimate connection with the bone it is very important that the musculo-spiral nerve should be dealt with in this manner.

From the manner in which the muscular section has been made it will be observed that as the tissues are drawn down preparatory to the introduction of the sutures the cut muscles help to conceal the divided humerus, which lies at the apex of a cone, the base of which is represented by the cut margins of the flaps.

The superficial tissues are connected by interrupted sutures of silkworm gut, or, if preferred, a few deep sutures of silkworm gut may be supplemented by a continuous superficial suture.

A perforated glass drainage-tube is introduced at the inner angle of the wound, and allowed to remain for twenty-four or forty-eight hours.

DISARTICULATION THROUGH THE SHOULDER-JOINT.

Indications.— Disarticulation at this level will be required mainly for severe crushing injuries of the limb ; sarcomata involving the humerus, or extensive disease of this bone.

Hæmostasis.—Hæmorrhage may be controlled by digital compression of the subclavian artery against the first rib, the direction of the pressure being downwards and backwards at the level of the supra-clavicular fossa. A more certain and more efficient method consists in exposing and ligaturing the brachial artery before its division after the superficial tissues have been divided.

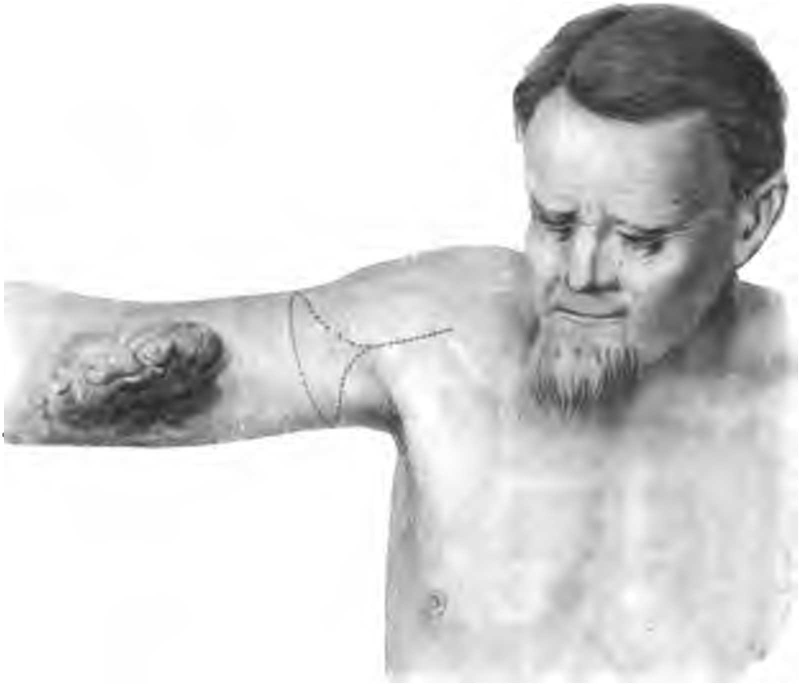

FIG. 13.—Outline of incision employed in disarticulation at the shoulder-joint by the method of Spence. (E. H. T.)

Disarticulation by a Racket Incision (Spence).—The patient lies with the affected shoulder projecting over the edge of the operating table. The surgeon stands in front and to the right side of the limb, which is slightly abducted and rotated outwards. One assistant holds and manipulates the limb, another stands opposite to the surgeon.

The incision commences just below and external to the tip of the coracoid process, and extends downwards through the anterior fibres of the deltoid muscle to a point corresponding to the lower border of

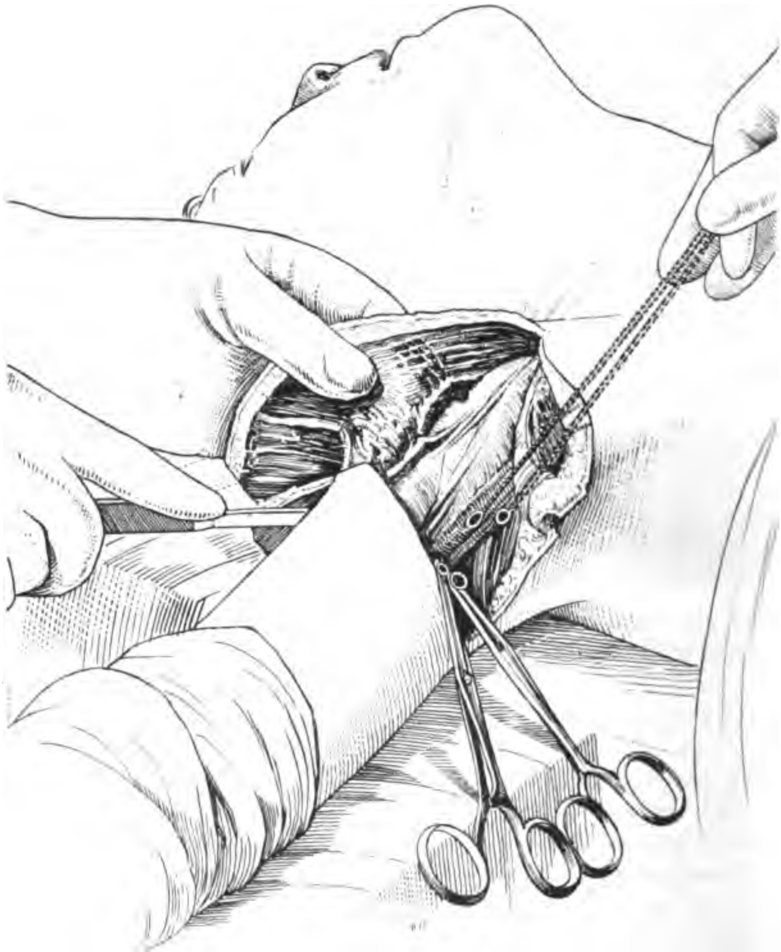

FIG. 14. — Disarticulation at the shoulder-joint by the method of Spence. The brachial vessels have been exposed and divided. The deltoid flap is being reflected. (E. H. T.)

the insertion of the pectoralis major tendon, all the tissues being divided down to the bone. From this point it is curved outwards and backwards through the lower fibres of the deltoid as far as the posterior axillary fold, and thence round the inner aspect of the arm to meet the lower extremity of the vertical limb (Fig. 14). In the latter part of this racket incision the superficial tissues only are divided. In the vertical cut through the deltoid muscle branches of the anterior circumflex artery and the acromial branch of the thoracic axis artery, as well as several small muscular branches, are divided and are immediately seized with hæmostatic forceps. The deltoid flap is dissected from off the humerus and the joint capsule, the cutting edge of the knife being directed against the bone.

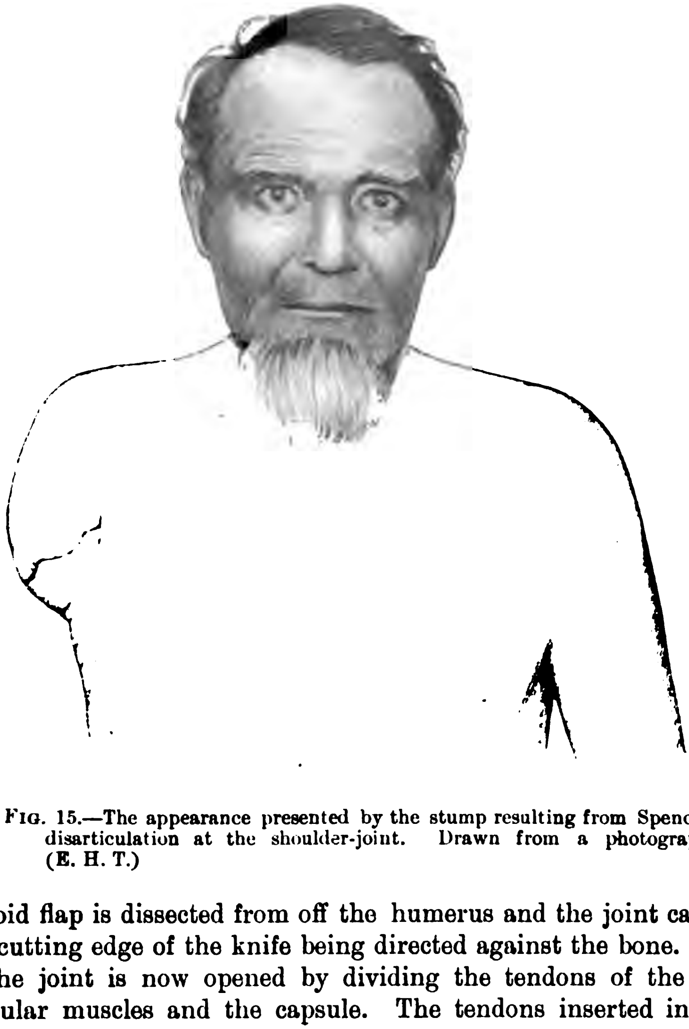

FIG. 15.—The appearance presented by the stump resulting from Spence's disarticulation at the shoulder-joint. Drawn from a photograph. (E. H. T.)

The joint is now opened by dividing the tendons of the short scapular muscles and the capsule. The tendons inserted into the great tuberosity will be divided most readily by rotating the limb inwards. The lesser tuberosity and the subscapularis muscle will be brought into view by rotating the limb outwards. The long tendon of the biceps also is divided against the head of the humerus.

The surgeon next directs his attention to the incision at the inner side of the limb and divides the coraco-brachialis and the short head of the biceps. The brachial vessels may now be exposed and divided between ligatures, unless this step has been carried out already.

The surgeon seizes the arm in his left hand and forces the head of the humerus upwards and outwards from the glenoid cavity. He thereupon insinuates the knife behind the bone, divides the posterior attachment of the capsule, and keeping the cutting edge of the knife close against the bone he clears it downwards for a short distance, and then directs the blade backwards so as to make it emerge behind through the transverse incision.

Any obvious vessels found bleeding are seized with hæmostatic forceps, and are either twisted or tied. The large brachial nerves are individually isolated and cut short.

The wound margins are brought together so as to have the cicatrix directed vertically.

A drainage tube is placed in contact with the glenoid fossa of the scapula and is made to emerge through the lower angle of the wound.

INTERSCAPULO-THORACIC AMPUTATION.

The upper limb is circumscribed by two curved incisions which join in front over the clavicle and behind at the level of the lower angle of the scapula.

The anterior incision follows the clavicle from its inner extremity outwards to a point near the coracoid process. From this it extends downwards and outwards about one inch to the outer side of the sulcus between the pectoralis major and deltoid muscles, and curves inwards beyond the anterior axillary fold across the inner aspect of the arm, and then over the posterior axillary fold, from which it descends to the level of the lower angle of the scapula (Fig. 16).

The posterior incision joins the anterior outside the mid-point of the clavicle. Leaving this, it crosses behind the acromio-clavicular articulation and extends over the acromion near to where it joins the spine of the scapula. It then descends to join the anterior incision at the level of the lower angle of the scapula (Fig. 17).

The shoulder should project beyond the side of the table. The surgeon stands at the inner side of the limb while marking out the anterior incision. He stands at the outer side of the limb during the resection of the clavicle and the division of the tissues in the posterior flap.

An assistant holds the limb and manipulates it in such a way as to facilitate the steps of the operation.

Berger's Operation—*Resection of the Clavicle, followed by Division of the Main Vessels and Nerves.*—The cutaneous incision follows the clavicle from within outwards for two-thirds of its extent, and then curves upwards and backwards. The periosteum is reflected at the outer side of the centre of the clavicle and the bone divided with a Gigli saw. The inner segment is seized with stout forceps, stripped of periosteum up to its inner extremity, and removed entirely. The subclavius muscle is divided and removed. This step leads to the exposure of the large axillary vein and artery and the nerves of the brachial plexus as they pass between the neck and the upper limb. They are crossed superficially by the suprascapular vessels, which are secured and divided between forceps. The axillary artery and vein are each isolated and divided between

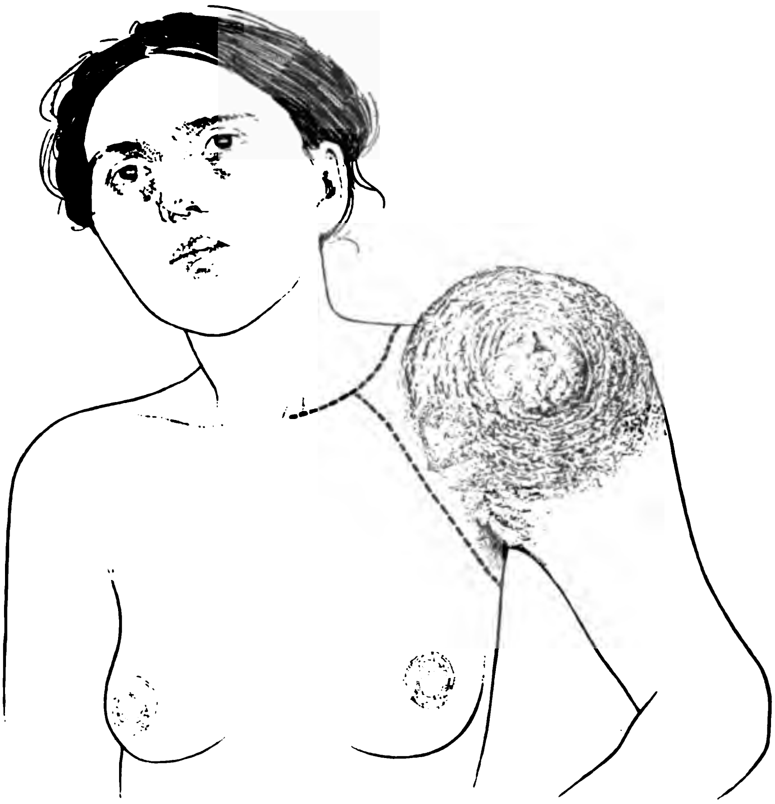

FIG. 16.—Interscapulo-thoracic amputation by the method of Berger for sarcoma of the humerus involving the shoulder-joint. The cutaneous incisions viewed from the front. From a photograph. (E. H. T.)

ligatures. The large nerves are divided as close to the neck as possible. Should bleeding proceed from some of the vessels in these nerves, the latter may be ligatured.

The Anterior Incision.—This is marked out in the direction already indicated. The superficial tissues are freely retracted, the pectoralis major muscle is divided close to the humerus and retracted inwards, the pectoralis minor muscle also is divided close to the coracoid process, and displaced inwards with the preceding. The limb now recedes from the trunk, and the axilla comes fully into view. The large vessels and nerves maintain a close relationship with the limb, and the branches passing from them to the thoracic wall are divided. Some fatty tissue covering the serratus magnus

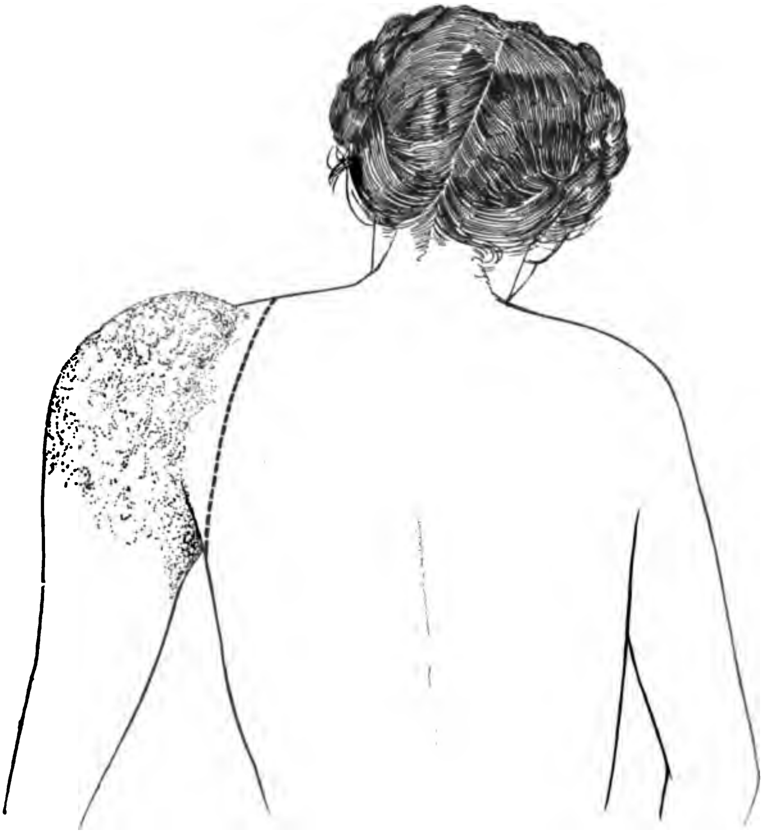

FIG. 17.—Interscapulo-thoracic amputation of the upper limb. The incision viewed from behind. From a photograph. (E. H. T.)

muscle is displaced with the aid of the finger, supplemented by a dry muslin swab, whereupon the deepest part of the recess between the scapula and the chest wall is exposed. The surgeon then completely frees the lower angle of the scapula by dividing the latissimus dorsi muscle.

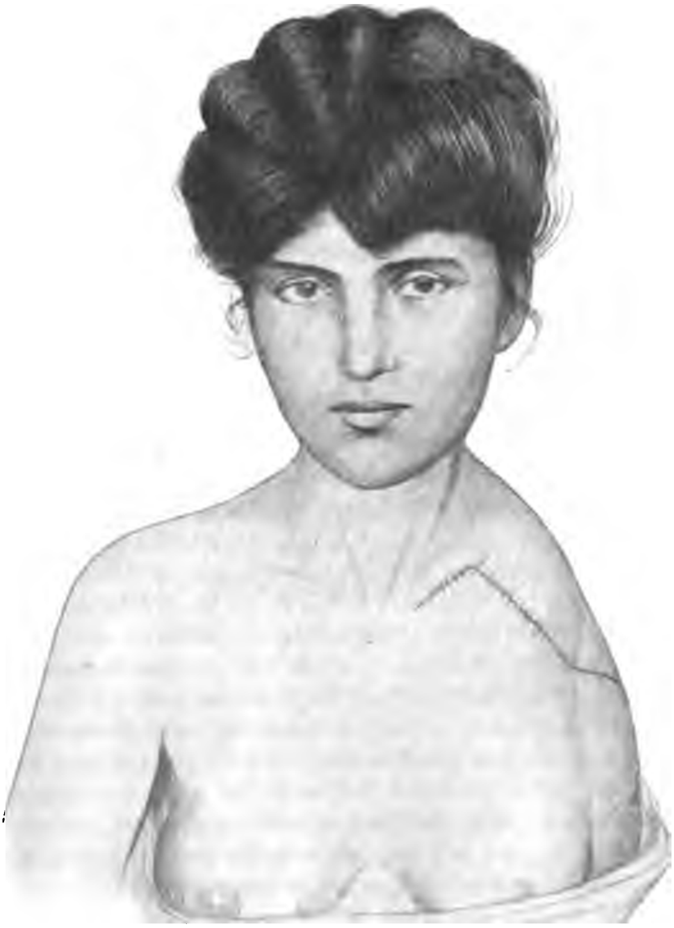

Fig. 18.—The appearance presented after interscapulo-thoracic amputation of the upper limb. Drawn from a photograph. Patient alive and well three years after the operation. (E. H. T.)

The Posterior Incision.—The limb is now drawn forwards across the chest. The direction of this incision has been already indicated.

It joins the anterior incision over the outer part of the clavicle, and extends downwards with a slight outward convexity to the lower angle of the scapula, where it rejoins the anterior incision at an acute angle.

The superficial tissues having been divided and retracted, the trapezius muscle is detached from the posterior border of the clavicle and from the spine of the scapula.

Detachment of the Scapula.—The limb is drawn forwards and outwards, and the posterior flap is fully retracted. This brings the upper border of the scapula into view, and the omohyoid muscle is divided, and behind it the levator anguli scapulæ. The posterior scapular artery is looked for, and if seen it should be secured by clip forceps and divided. The muscles attached to the vertebral border of the scapula are now divided, viz., the two rhomboids and the serratus magnus, the limb being drawn away from the side meanwhile. All bleeding vessels are secured by ligature, or torsion may be employed. A drainage tube is introduced into the lower angle of the wound. The wound margins are approximated by a series of interrupted sutures of silkworm gut, supplemented by a fine continuous suture for the cutaneous margins. The appearances presented by the individual following this operation are well seen in Fig. 18.

AMPUTATIONS OF THE TOES.

These resemble in type the operative procedures which have been described for the fingers. The principles which regulate these amputations are similar; those through the inter-phalangeal joints being performed with a long plantar flap, and those through the metatarso-phalangeal articulations by the racket type of incision.

In all amputations upon the toes the patient is placed in the supine position with the foot projecting beyond the end of the table. The surgeon sits or stands opposite to the foot, facing the patient, while his assistant stands at one side of the limb.

General Considerations Concerning Amputations of the Toes.—The amputation should be planned in such a way as to avoid a cicatrix upon the plantar aspect or either border of the foot. This object is best attained by adopting the dorsal racket incision, or a flap derived from the plantar tissues. In amputations through the first or fifth metatarso-phalangeal joints, as well as in the removal of the first or fifth toe with their respective metatarsal bones, the dorsal limb of the racket incision should be placed over the corresponding interosseous space rather than over the metatarsal bone so that the healed cicatrix will not be exposed to pressure.

Care is required when disarticulating at the metatarso-phalangeal joint of the big toe to provide sufficient tissue to cover the head of the metatarsal bone which is sometimes unusually large, and is rendered all the more prominent by the sesamoid bones.

Owing to the arched arrangement of the bones of the foot, the weight of the body is normally transmitted to the ground through the heel, the ball of the great toe, and the outer margin of the sole. In operations upon the great toe, therefore, it is important that as much of it as possible should be retained. Removal of the head of the metatarsal bone would seriously interfere with the functional capacity of the foot.

The four outer toes are relatively unimportant, and, as a rule, amputations through the metatarso-phalangeal joints are to be recommended in preference to those situated more distally. The stump left after amputation through an inter-phalangeal joint is apt to project dorsally, and to be subjected to pressure when a boot is worn.

Whenever it is possible, amputations through the first and fifth metatarsal bones are to be preferred to disarticulations at the tarso-metatarsal joints, as these bones help to transmit the weight of the body and furnish important muscular attachments by their basal extremities.

The metatarso-phalangeal joints are situated about one inch behind the free margin of the interdigital web. This fact is apt to be forgotten when disarticulations are being performed at this level.

Disarticulation of the Great Toe at the Metatarso-phalangeal Joint.—A convenient method of disarticulation at this joint consists in a circular or elliptical incision around the toe at the level of the free border of the web between it and the second toe, supplemented by a dorsal vertical cut directed backwards as far as the neck of the metatarsal bone and well to its fibular side.

The tissues are dissected away from the upper and inner aspects of the joint, the long extensor tendon of the great toe is divided and the articulation opened. By a few twisting movements the attachments of the phalanx are successively brought into view and divided.

The tissues are folded over the prominent head of the metatarsal bone, and when the sutures have been inserted the cicatrix will be found to lie to the outer side of the prominent head of the bone.

Farabœuf's Method.—In this procedure a large flap derived from the tissues upon the internal and plantar aspects of the toe is fashioned in such a way as to provide adequate covering for the head of the metatarsal bone.

The incision commences over the joint and at the inner side of the long extensor tendon. From this point it extends forwards as far as the neck of the first phalanx, whereupon it curves inwards, crossing beneath the toe obliquely to reach the web between the first and second toes. The remainder of the cut extends from the web by the shortest route to its starting-point on the dorsum, the toe held in the left hand being suitably manipulated meanwhile. The flap thus marked out on the inner side of the metatarso-phalangeal joint is raised, as much tissue as possible being included in it.

The joint is opened, and by twisting the phalanx its remaining ligamentous connections are brought into view and divided.

The wound is adjusted by a few deep sutures of silkworm gut, which at the same time exert a hæmostatic influence. Ligature of bleeding vessels is seldom required. The application of forceps for a few seconds, supplemented by torsion, usually suffices. Accurate coaptation of the wound margins will be secured by some additional superficial sutures of silkworm gut or horsehair.

AMPUTATIONS OF THE FOOT.

Amputation of the Metatarsus (Lisfranc's Amputation).

Indications.—Disarticulation at the tarso-metatarsal joint may be required in certain cases of injury or disease of the anterior part of the foot. Less frequently it may be indicated for cases of frost-bite or limited gangrene of the toes.

Instruments.—In addition to the usual instruments required for amputations, a short, stout knife will be found useful. That known as "Syme's foot-knife" is very suitable for this disarticulation as well as for others performed upon the tarsus and the ankle-joint.

Hæmostasis.—The limb is elevated for a few seconds, and while still held almost vertical a rubber tourniquet is applied to the upper part of the leg or the lower third of the thigh. Martin's red rubber bandage rolled four or five times tightly round the limb and made secure against slipping makes an excellent tourniquet; it is less severe upon the tissues than the strong, cylindrical rubber tubing usually employed.

Landmarks.—The line of the tarso-metatarsal articulations is recognised by two landmarks, one upon each lateral margin of the foot. On the outer border of the foot the prominent base of the fifth metatarsal bone is easily recognised. On its inner aspect the base of the first metatarsal bone is not always distinct, but its position may be indicated with sufficient accuracy by taking a point one inch in front of the prominent tubercle of the scaphoid bone.

The Dorsal Incision.—The surgeon, holding the metatarsus in his left hand, enters the knife upon the right border of the foot ½ inch behind the point indicating the level of the articulation. The incision follows the border of the foot for about one inch, and then extends across the dorsum of the foot parallel to the joint line and about ½ inch in front of it until the opposite border of the foot is reached. It is now carried back along this border of the foot and terminates at a point ½ inch behind the joint level. The tissues upon the dorsum are divided to the bones and dissected back sufficiently to expose the joint line.

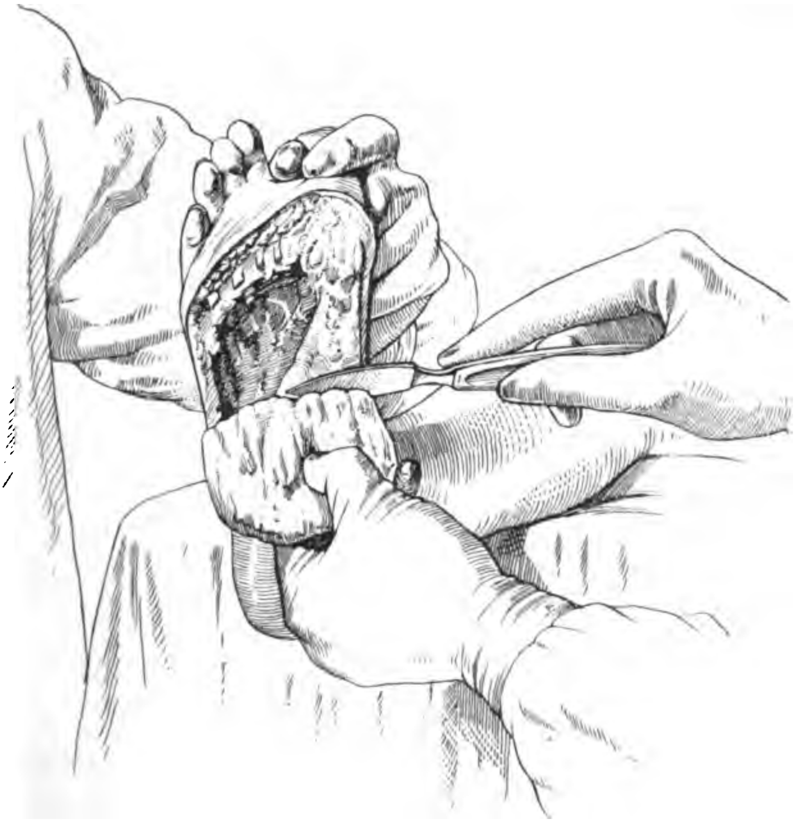

FIG. 19.—Lisfranc's disarticulation of the metatarsus. The plantar flap being reflected. (E. H. T.)

The Plantar Flap.—This large flap is outlined by an incision which, commencing at the original starting-point on the right margin of the foot, extends forwards to the level of the balls of the toes and then across the sole, with a slight convexity, to its left margin, along which it is carried to its termination in the left extremity of the dorsal incision.

This flap, which is broadly U-shaped, is longer upon the inner than upon the outer border of the foot. In cutting the skin the blade of the knife should be held at right angles to the surface, and care should be taken to prevent a bevelled incision.

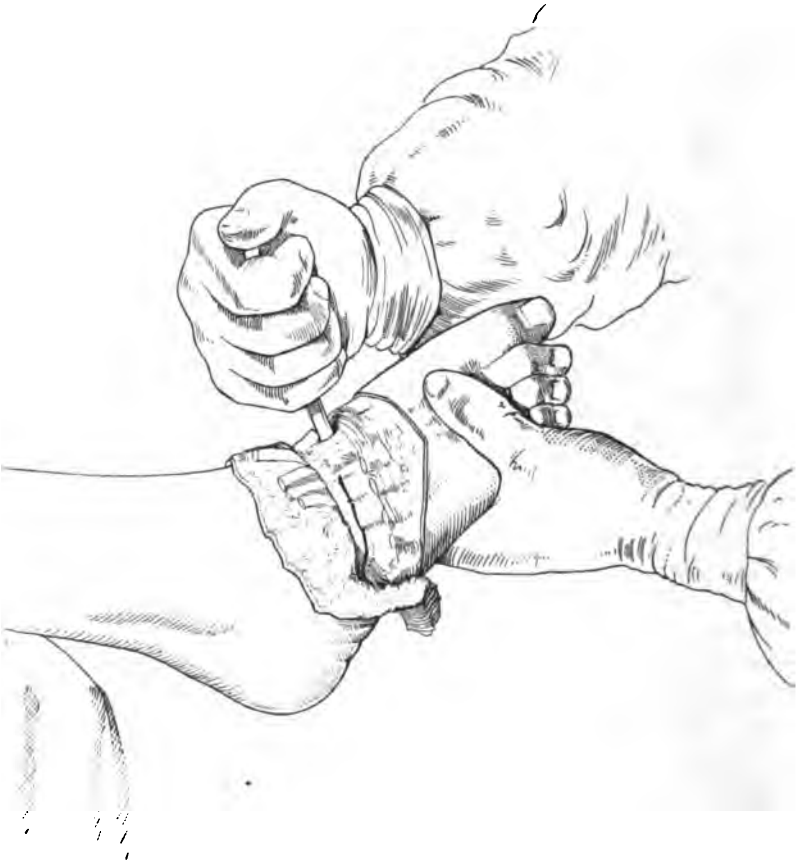

FIG. 20.—Lisfranc's disarticulation of the metatarsus. (E. H. T.)

In raising this plantar flap the superficial tissues alone are divided in the first ½ inch, but after this the section is carried to the bone, and all the tissues within the metatarsal concavity are detached (Fig. 19). Detachment of the flap is continued until the tendon of the peroneus longus muscle, obliquely directed from without forwards and inwards, is exposed.

Disarticulation.—The articulations of the three outer metatarsal bones are first opened by applying the point of the knife behind the base of the fifth metatarsal bone, and drawing it inwards and slightly forwards across the dorsum so as to divide the dorsal ligaments.

The disarticulation of the base of the first metatarsal bone is, perhaps, the chief stumbling-block in this operation; but it will be facilitated by keeping a full inch in front of the tuberosity of the scaphoid bone. Neglect to adopt this precaution frequently leads to opening of the scapho-cuneiform joint by mistake.

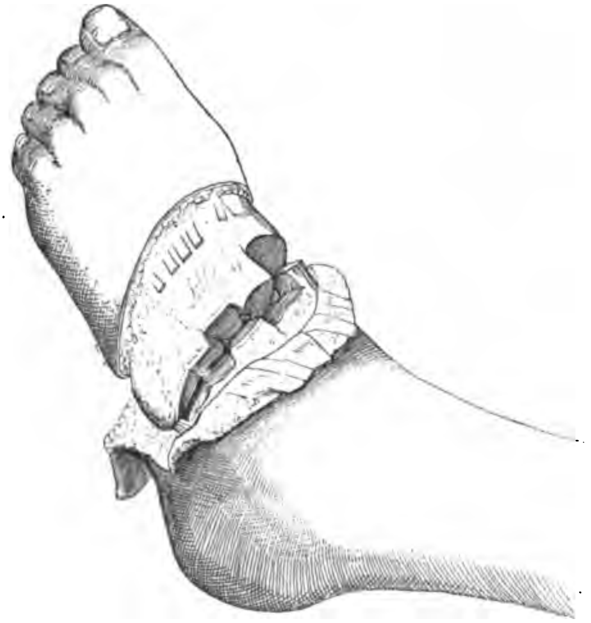

FIG. 21.—Disarticulation of the metatarsus. The tarso-metatarsal articulations opened and viewed from the dorsal aspect of the foot. (E. H. T.)

The base of the second metatarsal bone is disarticulated as follows: First divide the dorsal ligament, the position of which may be readily estimated with reference to the anterior extremity of the internal cuneiform bone, then grasping the knife like a dagger enter its point vertically between the first and second metatarsal bones, and with the cutting edge directed backwards divide the interosseous ligament connecting the second metatarsal with the internal cuneiform bone, carrying the line of section in the direction of the external malleolus (Fig. 20).

By forcibly depressing the anterior part of the foot the metatarsal articulations are opened out, and the remaining ligamentous connections are readily divided (Fig. 21). The plantar flap is adjusted by superficial and deep sutures of silkworm gut, and a drainage tube is inserted at each angle. Both tubes may be removed after twenty-four hours.

Comments.—The chief points to be borne in mind in performing this operation are (*a*) to make the plantar flap broad throughout and not with a tapering extremity; (*b*) to avoid cutting the skin in a sloping direction; (*c*) to define accurately the inner and outer extremities of the tarso-metatarsal joint line before disarticulating; and (*d*) to avoid cutting a dorsal flap. If this be done it may result in trouble from the scar being situated over the edge of the bone rather than over the dorsum of the foot.

Modifications of Lisfranc's Amputation. *Cooper's Modification.*—This consists in removing the fore part of the foot by sawing through the metatarsal bones just in front of their bases, and the procedure has certain advantages over Lisfranc's disarticulation. It preserves the attachments of the tibialis anticus, tibialis posticus and the three peronei muscles. The base of the fifth metatarsal bone also, which helps to support the foot, is retained and the large synovial cavity which extends forwards from the intercuneiform joints to the second and third tarso-metatarsal articulations is avoided.

Skey's Modification.—This resembles Lisfranc's procedure, except that instead of disarticulating the second metatarsal bone from the middle cuneiform it is sawn across a little in front of its basal extremity.

Hey's Modification.—Disarticulation of the metatarsus is effected as in Lisfranc's operation and, in addition, the anterior projecting extremity of the internal cuneiform bone is sawn off. This greatly improves the appearance of the stump.

Chopart's Disarticulation at the Mid-tarsal Joint.—In this procedure a long plantar flap is raised and disarticulation is effected through the mid-tarsal joint. This really is a double articulation between the os calcis and the cuboid externally; the astragalus and the scaphoid internally. The two articulations present an S-shaped outline, concavo-convex as one passes from the outer to the inner border of the foot.

Indications.—This operation has been performed in cases of injury and disease of the fore part of the foot. It cannot be said, however, to be a sound procedure for the removal of tuberculous disease affecting the metatarsus and the anterior part of the tarsus, as the surrounding infiltration of the soft tissues and tendon sheaths in addition to the osseous and articular disease is usually so advanced as to necessitate a more extensive operation.

Instruments.—As in Lisfranc's Disarticulation.

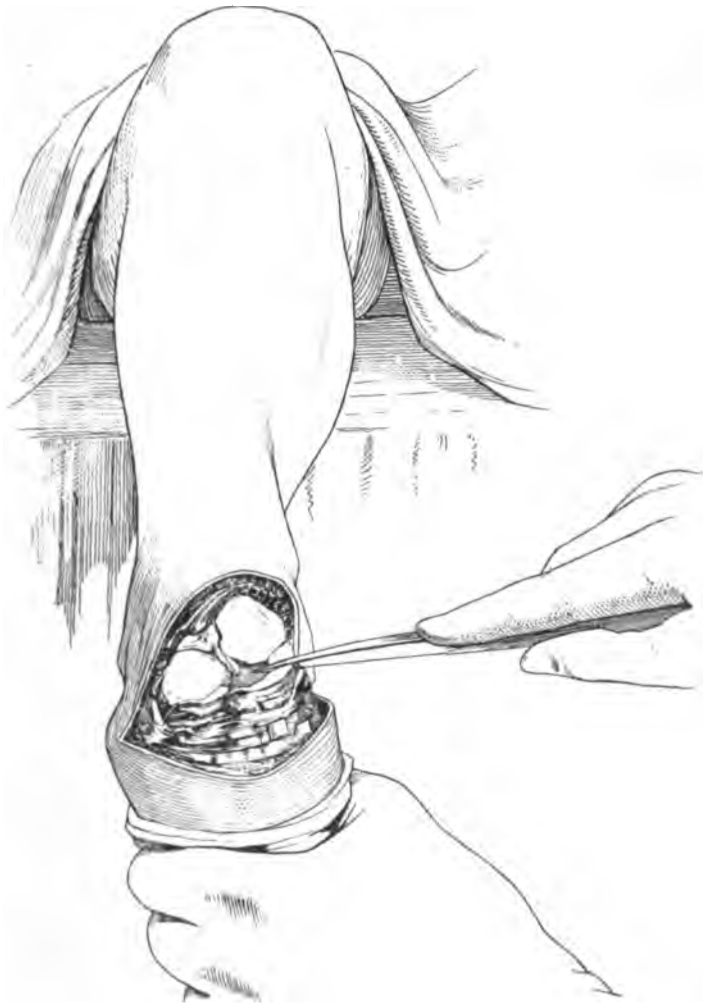

FIG. 22.—Chopart's medio-tarsal disarticulation. (E. H. T.)

Superficial Landmarks.—The level of the calcaneo-cuboid articulation is indicated upon the outer border of the foot by a point situated midway between the tip of the external malleolus and the base of the fifth metatarsal bone. The astragalo-scaphoid articulation lies behind the prominent tuberosity of the scaphoid bone upon the inner aspect of the foot.

Hæmostasis.—Bleeding is controlled as in Lisfranc's operation.

The Dorsal Incision.—This extends from a point ½ inch behind the joint line on one side to a corresponding point upon the opposite side of the foot. Between these points it first follows the margin of the foot for about 1 inch, and then extends across the dorsum with a slight forward convexity ½ inch in front of the joint line. When the superficial tissues have fully retracted the extensor tendons are divided down to the bones and the tissues are reflected until the line of the mid-tarsal joint is exposed.

The Plantar Flap.—This is a large U-shaped flap, and is outlined by an incision which commences and terminates at the extremities of the dorsal incision; it crosses the sole beneath the centre of the metatarsus, and in making it the point of the knife is held at right angles to the surface. The skin and subcutaneous tissues are first raised for about ½ inch, and then the entire thickness of the muscular strata in the concavity of the sole is divided and the flap is reflected back to the level of the mid-tarsal articulations.

The Disarticulation.—While the dorsal and plantar tissues are fully retracted, the astragalo-scaphoid articulation is opened from the inner side by dividing the tendon of the tibialis posticus muscle and the inferior calcaneo-scaphoid ligament immediately behind the tuberosity of the scaphoid bone (Fig. 22). By forcibly depressing the foot and dividing the dorsal ligaments and also the Y-shaped ligament of the mid-tarsal joint, the two articulations of which it is composed are widely opened. The remaining ligamentous connections are rapidly severed and the anterior segment of the foot removed. The tourniquet having been relaxed, any arteries which bleed freely are ligatured; the principal will be the dorsalis pedis and the two plantar arteries.

The plantar flap is adjusted over the end of the stump and is connected with the dorsal tissues by means of interrupted sutures.

A drainage tube may be introduced at each lateral angle of the stump and removed after twenty-four hours.

Comments.—When the weight of the body is transmitted to the stump following Chopart's amputation there is a tendency for the astragalus to be thrust forward beneath the tibia against the scar, and this displacement is further promoted by the tendo Achillis, which, by raising the heel, causes the tarsal segment to assume an attitude resembling that of talipes equinus. Tenotomy of the tendo Achillis has been recommended, but such a step does not result in a lasting improvement. In order to obviate this displacement also the extensor tendons upon the dorsum of the foot have been sutured to the plantar flap, but the result has not been satisfactory.

The tuberosity of the scaphoid bone is the key to the disarticulation. Unless this landmark be carefully identified there is a risk of opening the scapho-cuneiform articulations and leaving the scaphoid bone behind.

By approaching the mid-tarsal joint from the inner and plantar aspect of the foot there will be but little risk of entering the ankle-joint by mistake. This accident might readily occur, however, if the disarticulation were attempted from the dorsum.

Farabœuf's Subastragaloid Disarticulation.—In thisprocedure the entire tarsus, with the exception of the astragalus, is removed by disarticulation through the astragalo-scaphoid and astragalo-calcanean joints. A large flap is obtained from the internal and plantar aspects of the foot, and the extremity of the stump is invested by the tissues of the sole which are accustomed to withstand pressure; it forms a broad surface too, and is admirably adapted to transmit the weight of the body to the ground.

A tourniquet having been applied as in the preceding amputations, the foot is made to project beyond the end of the table, and the leg is strongly rotated inwards so that its outer surface looks upwards.

The Cutaneous Incision.—Assuming that the operation is being performed upon the right foot, the incision commences over the outer aspect of the tendo Achillis ½ inch below the level of the external malleolus. It passes forwards beneath this latter and parallel to the outer border of the foot to the level of the base of the fifth metatarsal bone, where it changes its course and curves across the dorsum to reach the inner aspect of the foot opposite the scapho-cuneiform articulation. From this it is next directed across the sole to a point on its external border just behind the base of the fifth metatarsal bone, and is continued backwards along the external plantar margin to the outer tuberosity of the os calcis, where it finally turns upwards, to terminate at its original starting-point beside the tendo Achillis.

The Disarticulation.—The incision just made is deepened all round to the bone, and the dorsal tissues are reflected until the head of the astragalus is exposed.

The astragalo-scaphoid joint is opened from its dorsal aspect, and while the foot is forcibly twisted inwards the knife is passed backwards between the articular surfaces of the astragalus and os calcis, dividing the strong interosseous ligament. The attachment of the tendo Achillis is divided, and the foot is still further twisted inwards until its superior or dorsal surface looks directly outwards. This facilitates the clearing of the internal and plantar surfaces of the os calcis, the cutting edge of the knife being kept close against the bone until separation is complete. While this is being done the foot is twisted more and more inwards until the sole looks directly upwards.

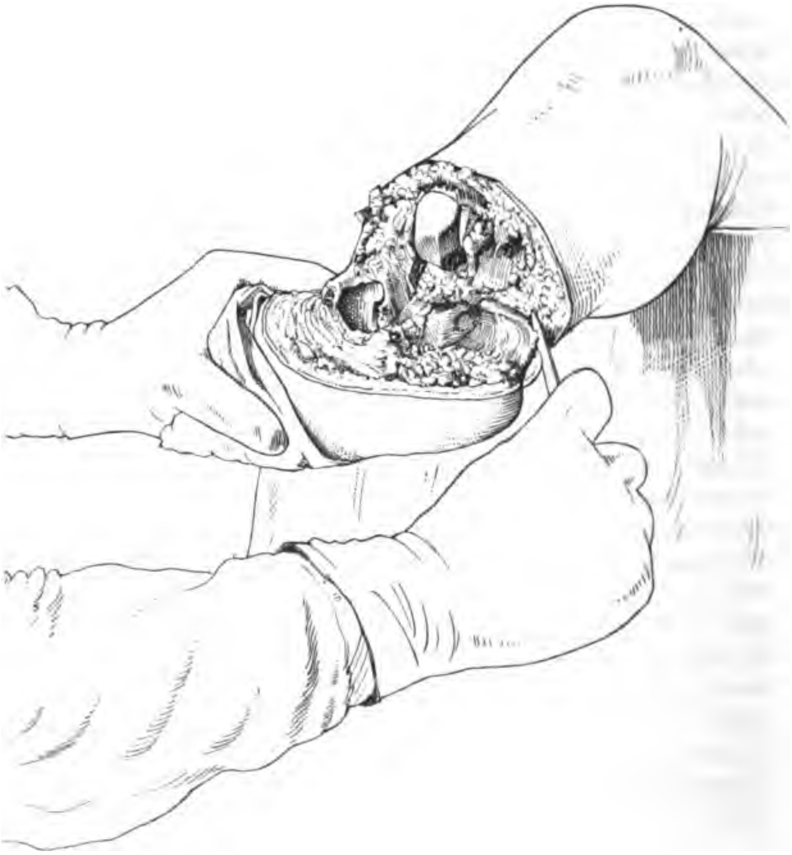

FIG. 23.—Farabœuf's subastragaloid disarticulation of the foot. (E. H. T.)

Projecting tendons are cut short, and a segment of the posterior tibial nerve is detached, the nerve having first been isolated and drawn down. Ligatures will be required for the dorsalis pedis and the two plantar arteries; other bleeding vessels are secured temporarily with clip forceps or are twisted.

On the Left Side. The Cutaneous Incision.—This commences at the inner side of the foot in front of the scapho-cuneiform articulation and curves across the dorsum to a point opposite the base of the fifth metatarsal bone. It is then directed backwards beneath the external malleolus to the outer border of the tendo Achillis. The surgeon now returns to the starting-point of the incision, and the limb being suitably held the incision is carried with a slight forward curve into the sole, and transversely across this aspect of the foot to its outer border, along which it is continued to the outer tuberosity of the os calcis, and finally curves up to terminate in the incision already made beside the tendo Achillis.

The Disarticulation.—The dorsal tissues are divided and the astragalo-scaphoid articulation opened. The interosseous ligament between the astragalus and the os calcis is next divided, and the foot twisted inwards until the articular surface of the os calcis looks backwards (Fig. 23).

The tendo Achillis is detached and the tissues are separated from the inner aspect of the os calcis, the vessels and nerves being carefully guarded by keeping the cutting edge of the knife close against the bone.

The remaining steps resemble those already described.

Drainage.—A stab wound is made at the posterior part of the flap beside the tendo Achillis and a drainage tube is inserted.

The wound is closed by deep and superficial sutures of silkworm gut.

Comments.—The functional result following this operation is very good, and when the local conditions are favourable it may be performed in preference to Syme's disarticulation at the ankle-joint.

If the incision in the sole be not situated sufficiently far forwards, or if it be made with too great a degree of obliquity, there may not be a sufficient amount of tissue available to cover the head of the astragalus. It may be necessary then to remove the head of the bone.

An artificial foot may be fitted to the stump after an interval of two months.

DISARTICULATION AT THE ANKLE-JOINT.

Syme's Operation.—In this operation the entire foot is removed by disarticulation through the ankle-joint, the malleoli are detached, and a stout flap consisting of the tissues of the heel is adjusted beneath the tibia and fibula.

Indications.—The conditions for which this procedure is most commonly indicated are: injuries of the foot; tuberculous disease of the tarsus; certain cases of gangrene of the foot; new growths and aggravated cases of talipes resulting from infantile paralysis.

Instruments.—In addition to those usually required for an amputation, Syme's foot-knife is to be recommended.

The circulation is controlled by a rubber tourniquet applied to the lower part of the thigh.

The position of the foot is similar to that described for Lisfranc's disarticulation of the metatarsus. The surgeon grasps the foot and marks out the incision for the heel flap. This extends from the tip of the external malleolus beneath the foot to a point ½ inch beneath the tip of the internal malleolus. At the sides of the foot it runs vertically, or with a slight inclination backwards if the heel is at all prominent, and transversely across the sole. Another incision is now carried across the front of the joint, connecting the extremities of the one already made; it extends through all the tissues down to the bones (Fig. 24).

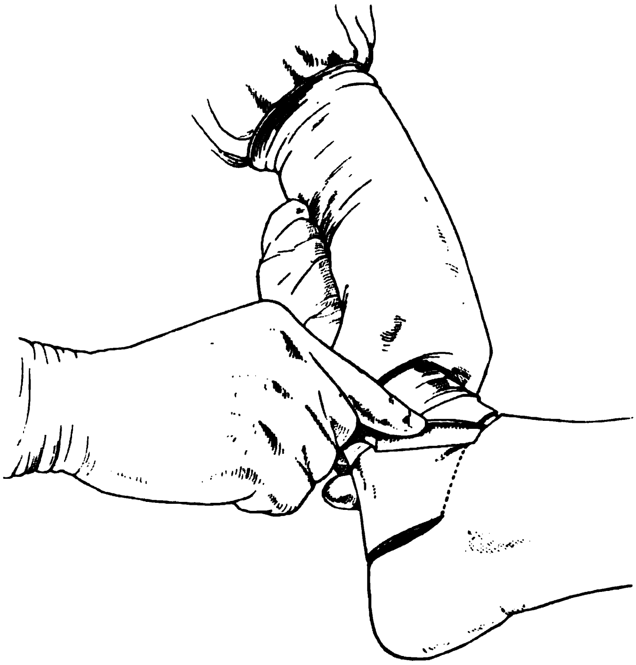

FIG. 24.—Syme's method of disarticulation at the ankle-joint. The cutaneous incisions. (E. H. T.)

The anterior and lateral ligaments are divided. The latter are reached most easily by placing the edge of the knife against the tip of each malleolus, and cutting from below upwards. By forcibly depressing the foot the joint is opened, the posterior ligament is thereupon exposed and divided, and the superior non-articular surface of the os calcis is brought into view.

The incisions at the sides and under surface of the os calcis are deepened to the bone. If the foot be now firmly held and bent backwards, the os calcis will be stripped of its periosteal covering and the tendo Achillis exposed. This is detached from the bone, and by still further depressing the foot the tissues investing the plantar aspect of the os calcis are exposed and detached (Fig. 25). In young subjects the scale-like epiphysis at the back of the os

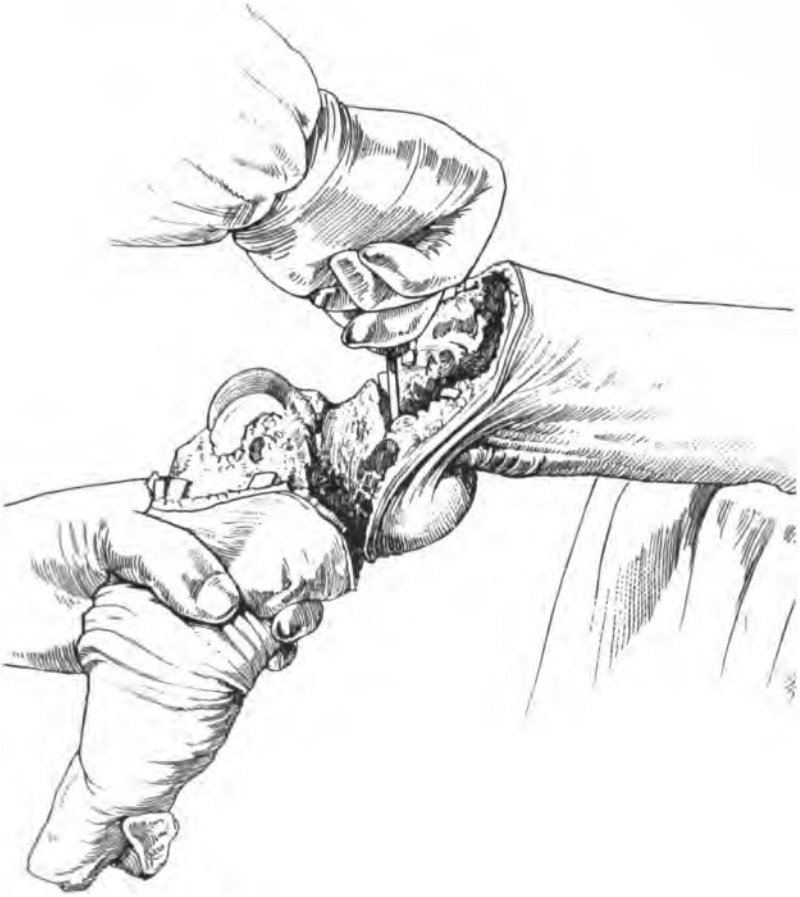

FIG. 25.—Syme's method of disarticulation at the ankle-joint. Dissecting the heel flap from off the os calcis. (E. H. T.)

calcis strips off with the periosteum and is retained in the heel-flap.

The malleoli are cleared of their investing tissues and sawn off. As a rule it is not necessary to remove the articular cartilage from the under surface of the tibia.

The anterior tibial and the two plantar arteries are ligatured. The anterior and posterior tibial nerves are isolated, drawn down and about one inch of each removed.

A stab wound is made posteriorly at the outer side of the tendo Achillis and a piece of rubber tubing or a perforated glass drainage tube inserted to act as a drain for forty-eight hours.

The heel-flap is adjusted by means of interrupted sutures of silkworm gut, and in applying the dressings care is taken to prevent the stump from being subjected to an undue degree of compression by the bandaging, as this might injuriously affect the vitality of tissues already poorly nourished.

Comments.—This operation gives admirable results ; the stump is covered by the normal tissues of the heel, which are tough and accustomed to stand pressure, and the cicatrix is placed anteriorly, where it is safe from injury.

Some precaution is necessary in marking out the heel-flap. The chief blood-supply of this flap comes from the internal calcanean branch of the external plantar artery, and as this vessel lies but a short distance behind the internal limb of the incision, either it, or possibly the posterior tibial trunk, will be wounded if the incision be made behind the prescribed level, and sloughing of the heel-flap will be likely to ensue. On the other hand, if the heel incision be directed forwards on each side the flap will be unnecessarily long, and great difficulty will be experienced in stripping the os calcis of its coverings. The anterior incision should follow the line of the ankle-joint accurately. If carried too far forward the astragalo-scaphoid articulation may be opened by mistake.

As a rule it is easy to denude the os calcis of its periosteum, especially in young subjects, in whom the foot has probably been diseased for some time and the bones are atrophic in consequence.

Pirogoff's Amputation.—This procedure closely resembles that of Syme but differs from it in that the posterior part of the os calcis is retained in the heel-flap, and its sawn surface is brought into contact with those of the tibia and fibula.

Indications.—Same as for Syme's amputation.

Hæmorrhage is controlled by means of a tourniquet applied to the lower part of the thigh.

The heel-flap is outlined by an incision which extends from a point below and in front of the external malleolus downwards and slightly forwards and then across the sole, to terminate on the inner side of the ankle in front of the tip of the internal malleolus. The extremities of this incision are connected by another, which curves across the dorsum of the foot with a slight forward convexity just in front of the line of the ankle-joint. The tissues are divided to the bone and allowed to retract. The ankle-joint is now opened, the lateral ligaments are divided and disarticulation is effected as in Syme's amputation.

By drawing the foot forward the posterior non-articular surface of the os calcis is exposed and the tissues of the heel-flap are dissected back for a short distance, the knife edge being kept in close contact with the bone.

The posterior part of the os calcis is now detached, the saw traversing the bone vertically about ½ inch behind the astragalus, the tissues of the heel being carefully protected from injury meanwhile.

The lower extremities of the tibia and fibula are stripped of their investing tissues and the second section made. This traverses the bones from before backwards with a slight degree of obliquity, commencing at the anterior margin of the tibial articular surface and terminating behind about ½ inch above the articular surface.

Any tendons which protrude are snipped away. The anterior tibial and plantar arteries are ligatured, and the corresponding nerves are cut short.

The os calcis is brought into contact with the extremities of the tibia and fibula, and the wound is adjusted by sutures as in Syme's amputation.

Comments.—The chief advantages claimed for this operation over that of Syme are that a somewhat longer stump is provided, there is less risk of sloughing of the tissues of the heel-flap, and as the detached portion of the os calcis fills up the space between the bones of the leg and the tissues of the heel-flap there is not the same likelihood of blood or serum being retained. It has been shown by experience, however, that the functional results following Pirogoff's amputation are not as good as those after the procedure of Syme.

If the extremity of the os calcis does not come readily into contact with the tibia and fibula it may be made to do so by dividing the tendo Achillis. This will also help to prevent subsequent drawing up of the heel-flap.

Accurate approximation of the bony surfaces is of great importance, as bony union is essential for a good functional stump. With this object in view it may be advisable to bring the bones into accurate contact with steel screws or nails. Chromicised catgut sutures passed through holes drilled in the bones have been employed with success.

AMPUTATIONS THROUGH THE LEG.

The site selected for amputation through the leg varies with the circumstances of the individual case. It may be in the upper, middle, or lower third. The term "seat of election" was used to indicate a point a hand's breadth below the knee-joint, as it was here that amputations were usually performed in by-gone years, and it was selected because it provided a short movable stump, which was well adapted for supporting the weight of the body when fitted with the old-fashioned peg stump.

Indications.—The chief conditions requiring amputation through the leg are: extensive injuries of the foot; certain cases of gangrene; aggravated case of compound fracture; extensive tuberculous disease of the tarsus, in which the ankle-joint is involved, and malignant disease of the foot.

Supramalleolar Amputation (Guyon). — This amputation is performed through the lower third of the leg by a posterior elliptical incision, and the bones are divided close to the bases of the malleoli.

The Cutaneous Incision.—The ellipse has its highest point in front, about a finger's breadth above the line of the ankle-joint. Its lowest point corresponds to the projection of the heel, and between these points it describes a curve on each side in front of the respective malleoli.

When the superficial tissues have been freely divided and allowed to retract, the section is carried through all the soft structures down to the bone. The heel-flap, which includes the tendo Achillis, is detached, and while this is being done the cutting edge of the knife is directed against the bone.

The Bone Section.—The lower extremities of the tibia and fibula are cleared up to a point about two inches above the joint, and while the tissues are carefully retracted the bones are divided.

Ligatures are applied to the anterior tibial, posterior tibial and peroneal arteries. The tibial nerves are isolated and cut short.

The heel-flap is adjusted over the ends of the bones, and the wound is closed by interrupted sutures, of silkworm gut.

If drainage be deemed necessary, a small glass or rubber tube may be inserted for the first twenty-four hours.

Comments.—The stump is well covered by the tough tissues of the heel, and the cicatrix lies anteriorly, well removed from pressure.

There is very little sacrifice of healthy tissues, and it is possible to make a very low section of the bones.

This amputation is to be preferred to the disarticulation of Syme in cases of tuberculous disease of the tarsus in which the ankle-joint is involved.

It is not necessary to open into the ankle-joint during the procedure, but the amputation is rendered easier by disarticulating and removing the foot as in Syme's operation.

Amputation in the Lower Third of the Leg by a Posterior Elliptical Incision. The cutaneous incision resembles the incision described in the preceding amputation. The line of bone section having been determined, the highest point of the ellipse will lie on the anterior aspect of the limb at a distance below the plane of section equal to half the antero-posterior diameter of the limb at that level; the lowest point of the ellipse crosses the back of the limb at a distance below the plane of section equal to the antero-posterior diameter.

The skin having been divided and allowed to retract, the muscular strata are divided down to the bones in the oblique plane of the retracted edge of the skin. The tissues are next retracted and detached from the bones to a point just above the site selected for the bone section.

The bones are sawn across, and if necessary the anterior sharp margin of the tibia is removed by a bevelled section.

The tibial and peroneal vessels are ligatured, and the two tibial nerves are cut short. When the wound is sutured the cicatrix will lie horizontally on the anterior aspect of the limb.

Teale's Amputation.—In this operation a long rectangular flap, equal both in length and in breadth to half the circumference of the limb at the plane of bone section, is raised from the front of the limb. A posterior flap is also raised; it is equal to one-third the length of the anterior.

The Anterior Flap.—Having determined the dimensions of the anterior flap, its lateral margins are outlined by two longitudinal incisions, which descend respectively behind the posterior border of the tibia on the inner side and the posterior border of the fibula on the outer side of the limb. These incisions are connected below by a transverse cut across the anterior aspect of the limb.

The tissues are next divided down to the bones and the interosseous membrane, and the large flap is raised. It includes all the tissues in front of the bones, and particular care should be taken to preserve the anterior tibial artery, which is exposed on the deep aspect of the muscles throughout the entire length of the flap.

The Posterior Flap.—A transverse incision is carried across the posterior aspect of the limb at the level previously determined. All the tissues are divided down to the bones, and the flap is raised up to the level of the saw-cut.

The Bone Section.—The interosseous membrane is divided and the tissues composing the flaps are held aside by a three-tailed retractor. When the crest of the tibia is thin and prominent at the plane of section, so that a sharp angle would result from a simple transverse division, an oblique section must be made so as to obtain a rounded end to the bone. An oblique cut is first made starting about ¾ inch above the plane of section, and extending downwards and backwards very obliquely through the bone. The saw is then withdrawn and the transverse section made. It is well to complete the section of the fibula before the shaft of the tibia is fully divided.

The anterior tibial, posterior tibial and peroneal arteries are ligatured, and both tibial nerves are cut short.

The large anterior flap is folded over the end of the stump, and its lower extremity is bent upon itself so as to meet the lower cut extremity of the posterior flap.

The wound is closed by a series of interrupted sutures of silkworm gut. The first sutures are placed one on each side at the level of junction of the flaps.

Comments.—This amputation is rarely performed. It necessitates a very high division of the bones owing to the great length of the anterior flap. An excellent covering is provided for the bone, however, and the cicatrix is not exposed to pressure.

Lord Lister's Amputation.—This amputation is somewhat similar to that of Teale just described, but it permits of a lower division of the bones as the anterior flap is not quite so long.

The Anterior Flap.—This flap is equal in length to the antero-posterior diameter of the limb at the level of the bone section, and in width it is equal to half the circumference of the limb at the same level. It is outlined by carrying two vertical incisions down the lateral aspects of the limb, and connecting these by a slightly curved transverse incision.

The Posterior Flap.—This is outlined by a curved incision crossing the posterior aspect of the limb about one inch below the site selected for the division of the bones.

In raising the anterior flap all the tissues in front of the bones and the interosseous membrane are detached, and the anterior tibial artery is carefully preserved as the flap is being raised from the interosseous membrane.

The bones are cleared, the interosseous membrane is divided and the tissues are retracted as in Teale's amputation. The saw-cut is then made, and the sharp crest of the tibia is bevelled off in the manner already described.

The tibial and peroneal arteries are ligatured, and the tibial nerves are cut short.

The anterior flap covers the end of the stump and meets the posterior flap at the back of the limb. In introducing the sutures the best method is to connect the flaps first at their mid-points so as to subdivide the wound into two equal parts. The two succeeding sutures in a similar way subdivide these segments into areas of equal extent, which are adjusted by a suitable number of intervening sutures. This method of spacing wounds in bringing amputation flaps together is useful, as it prevents a redundancy of tissue at either extremity of the larger flap.

Amputation through the Lower Third of the Leg by a long Posterior Flap.—A long flap is raised from the back of the leg. It exceeds somewhat in length the antero-posterior diameter of the limb at the level of the bone section, and it includes all the tissues down to the bones and the interosseous membrane.

The Posterior Flap.—The circumference of the leg is taken at the level of the proposed saw-cut, and the width of the posterior flap, which is equal to half of this, is indicated by a superficial mark made by the point of the knife on each side. The length of the flap slightly exceeds the antero-posterior diameter at the same level. The level of its free extremity is also indicated by a superficial mark on the skin on the back of the leg.

The flap is fashioned as follows: A vertical incision, *i.e.*, in the long axis of the limb, is made on each side through the superficial tissues, commencing above at the mark already made at the base of the flap. These lateral incisions run parallel to the posterior border of the limb, and consequently as they descend they will incline more and more towards the anterior tibial border. The limb being raised, the lower convex margin of the flap is made by drawing the knife with a slight curve across the back of the leg at the level already determined from one vertical incision to the other. The superficial tissues having been divided and allowed to retract, the tendo Achillis is divided at the level of the retracted skin and raised for a short distance. The deep muscles are then dealt with in the following way: Two vertical cuts are made, one immediately behind the posterior tibial margin and another behind the fibula. The knife is maintained in close contact with the bones while the muscles are being detached. A little manipulation now with the fingers and a blunt dissector will suffice to raise the muscles, together with the blood vessels and nerve, from contact with the bones and the interosseous membrane. A knife is entered into the space so made between the bones and the muscles, and its cutting edge being directed backwards, it is made to cut through the intervening bridge of tissue at the level of the free border of the flap (Fig. 26). By a few additional touches of the knife the flap is detached quite up to its base.

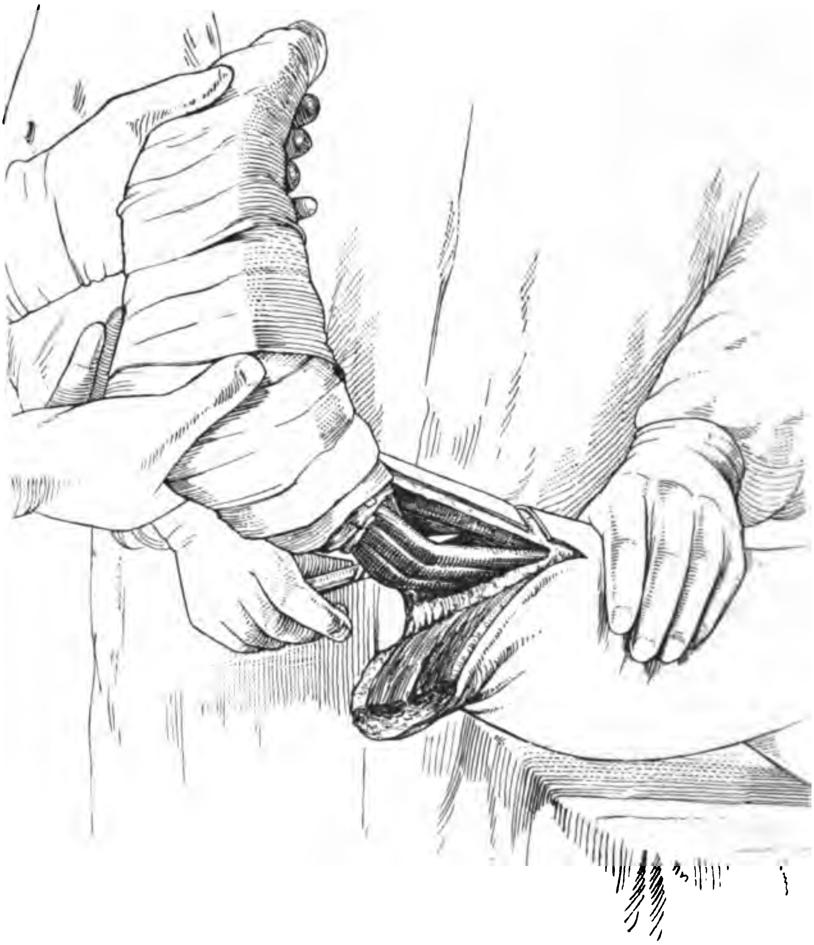

FIG. 26.—Amputation through the leg by a long posterior flap. Method of dividing the deep muscles from within outwards (E. H. T.).

The Anterior Flap.—This measures in length about a third of the posterior. It is fashioned by making a curved incision across the front of the limb connecting the original vertical cuts. When the superficial tissues have retracted, the muscles are divided down to the interosseous membrane and are raised together with the anterior tibial vessels.

The interosseous membrane is divided, and both flaps are fully retracted. The bones are sawn across and the sharp crest of the tibia is removed in the manner already described.

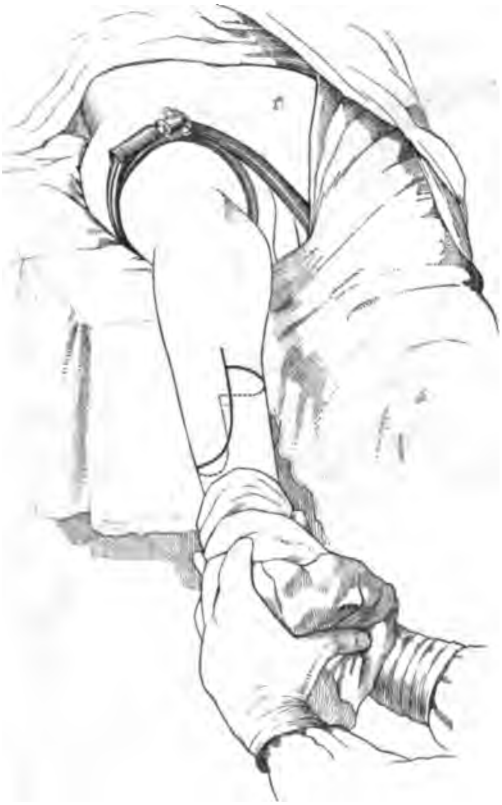

FIG. 27.--Farabœuf's method of amputation through the leg. The cutaneous incisions (E. H. T.).

The tibial and peroneal arteries are ligatured, and the nerves are cut short.

The cicatrix which results from the union of the flaps is situated well to the front of the stump, and is not exposed to pressure; the ends of the bones, too, are well covered.

This amputation may also be performed in the middle third of the leg; the details of the procedure are similar to those just described.

Amputations through the Leg at the "Seat of Election." *Modified Circular Amputation by Lateral Flaps.*—The site for the bone section having been determined, viz., a hand's breadth below the upper articular surface of the tibia, two lateral flaps consisting of the superficial tissues of the leg are raised below this. Each lateral incision commences about one inch below the level of the bone section and just outside the anterior tibial crest. It descends vertically at first, and then curves around the lateral aspect of the limb to its posterior aspect, where it turns abruptly upwards, to terminate at a point exactly opposite that in front. The outer flap should be equal in length to half the transverse diameter of the limb at the level of the saw-cut. The internal

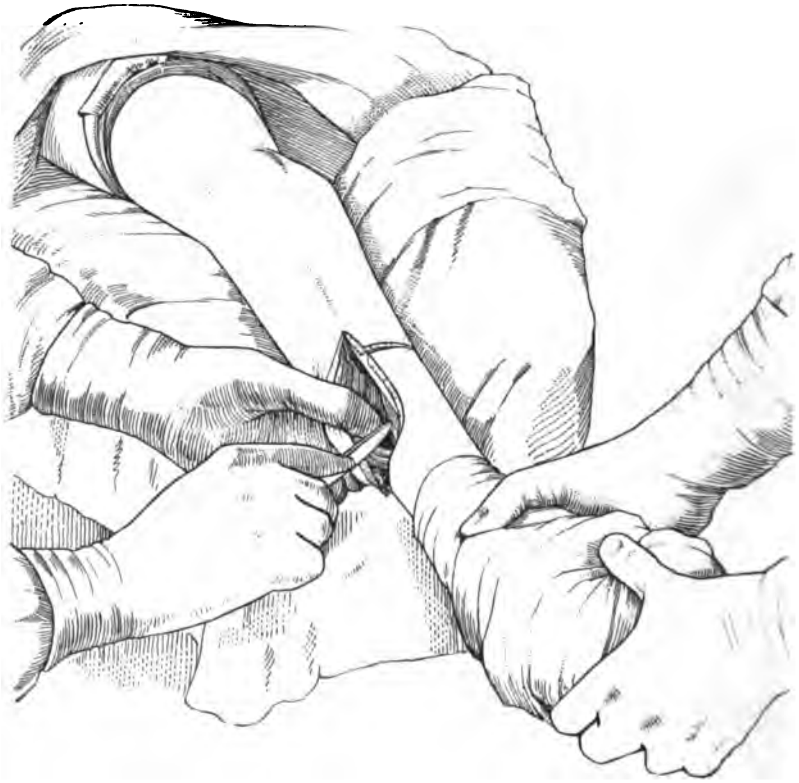

FIG. 28.—Farabœuf's method of amputation through the leg. Raising the large external flap (E. H. T.).

flap is somewhat longer in consequence of the large tibial surface which it has to cover.

The flaps are dissected up to their bases, all the superficial tissues being raised, and the cutting edge of the knife is directed towards the deep fascia.

The muscular strata are divided circularly at the bases of the retracted flaps. The interosseous membrane is cut, the bones are cleared, and a suitable three-tailed retractor applied. The bones are sawn across and the tibial crest is removed as before.

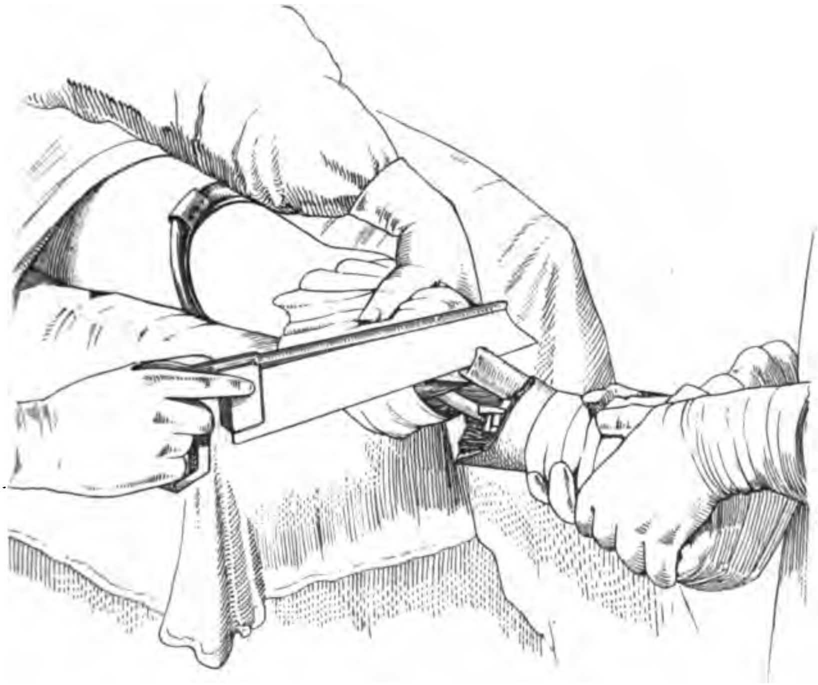

FIG. 29.—The bone section in Farabœuf's amputation through the leg (E. H. T.).

The tibial and peroneal arteries are ligatured, and the tibial nerves are cut short.

The two flaps are sutured together, and a drainage tube is introduced between them posteriorly for the first twenty-four hours.

This amputation is well adapted to this level. It is simple and may be performed rapidly. It also affords a neat stump, and the fact that the cicatrix is terminal is not a disadvantage if a peg stump be subsequently applied to the limb.

Farabœuf's Amputation.—A large U-shaped flap exceeding somewhat in length the transverse diameter of the limb is raised from the outer aspect of the leg. The remaining tissues and the bones are divided transversely at the level of the base of this flap (Figs. 28 and 29).

The External Flap.—The incision which outlines this flap commences in front, immediately to the inner side of the crest of the tibia, a hand's breadth below the upper articular surface of this bone. At first it descends vertically, and then curves around the outer aspect of the limb to the middle of the calf, where it is directed upwards to terminate at a point one inch below the level of its starting-point in front. The superficial tissues are divided all round and are allowed to retract.

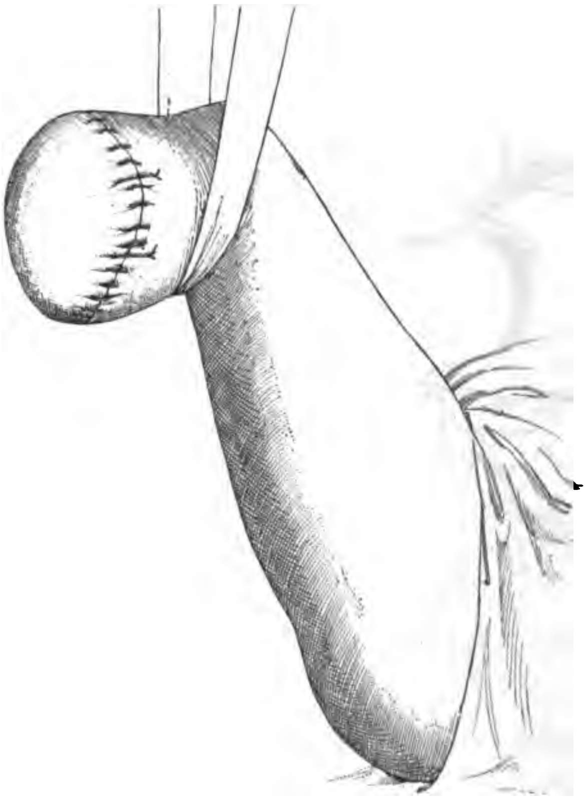

FIG. 30.—The appearance presented by the stump after the introduction of the sutures in Farabœuf's amputation through the leg (E. H. T.).

The incision on the inner side may now be marked out. It extends from the upper extremity of the U-shaped incision behind, around the limb, with a slight downward convexity, to a point in front about 1½ inches below the upper extremity of this latter incision.

The large external flap is now raised, and in doing so care is taken to include all the soft tissues down to the bones; the anterior tibial artery, too, should be raised and carefully protected from injury.

The muscles at the inner side of the limb are completely divided after the manner of a circular amputation, and dissected up from the bones for a short distance.

The interosseous membrane is divided, a three-tailed retractor is applied, and the bones are sawn across in the manner already described. It is an advantage to divide the fibula slightly higher than the tibia, and to have its cut surface sloping from without downwards and inwards. The tibial and peroneal arteries are ligatured, and the nerves are cut short.

A drainage tube is introduced for the first twenty-four hours.

The large external flap is drawn across beneath the cut surfaces of the bones, and it is connected with the margin of the transverse incision at the inner side. It provides an excellent covering for the bones, and the cicatrix is situated upon the inner aspect of the stump (Fig. 30).

DISARTICULATION AT THE KNEE-JOINT.

Indications.—Disarticulation at this level is mainly required for one of the following conditions: Sarcoma of the tibia or fibula; extensive necrosis of these bones; some cases of malignant disease (epithelioma) originating in the skin lower down; senile gangrene of the foot.

Position of the Limb, etc.—The leg and the lower half of the thigh should project beyond the end of the table. The operator stands at the right side of the limb, his chief assistant stands opposite, and another assistant manipulates the leg.

Hæmorrhage is controlled by an Esmarch's tourniquet applied to the upper third of the thigh.

Stephen Smith's Operation.—Two lateral flaps, consisting of the superficial tissues, are raised as follows: A point is selected in front one inch below the tubercle of the tibia, and from this, each incision extends at first vertically downwards for a short distance, and then curves across the lateral aspect of the limb about 3 inches lower down. Having reached the posterior surface, it curves upwards to its termination opposite the centre of the knee-joint.

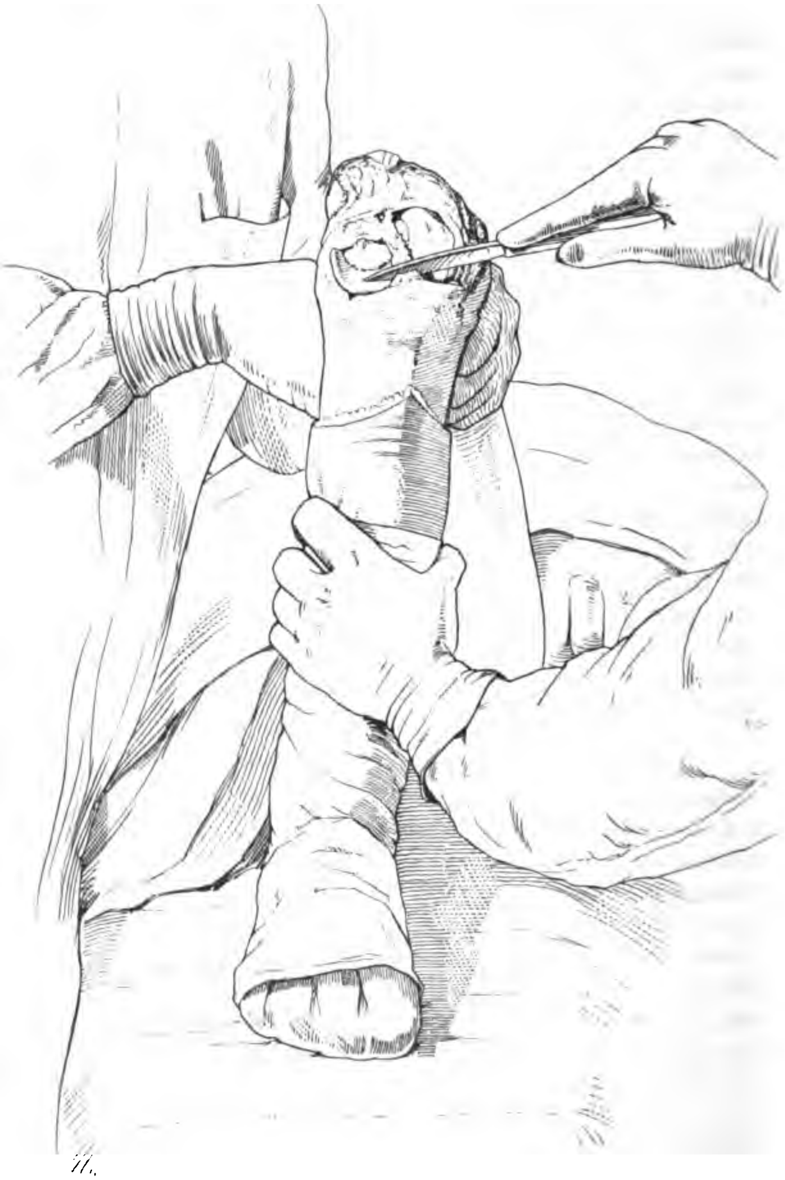

FIG. 31.—Disarticulation at the knee-joint by the method of Stephen Smith (E. H. T.).

The flap on the inner side may be fashioned somewhat longer than its fellow owing to the greater size of the internal condyle.

The flaps are raised on each side, and the ligamentum patellæ is divided at its insertion into the tibial tubercle.

Having reached the horizontal level of the joint, the capsule is divided in front and on each side at the level of the upper border of the tibia below the line of attachment of the semilunar cartilages. These latter are carefully detached, and the attachments of the crucial ligaments are divided.

The joint having now been fully opened, the cutting edge of the knife is directed backwards, and with the leg straightened somewhat the tissues at the back of the joint are divided, the line of incision inclining slightly downwards as well as backwards.

The popliteal vessels are ligatured, and the popliteal nerves are cut short. The tourniquet is then removed, and certain of the articular arteries which bleed are also secured by ligature. The flaps are sutured and a drainage tube inserted. The cicatrix lies entirely on the posterior aspect of the limb, opposite the deep intercondyloid notch of the femur.

Disarticulation at the Knee by an Anterior Elliptical Incision.—The lowest point of the ellipse is situated in front of the tibial crest at a distance below the joint line equal to the antero-posterior diameter of the limb; the highest point is at the back of the limb, half this distance below the joint line.

The incision is outlined as described, and the superficial tissues are divided all round; these are then raised in the form of a cuff as far as the lower extremity of the femur.

The ligamentum patellæ is divided, and the disarticulation is carried out exactly as described in the preceding operation (Stephen Smith's).

The vessels are ligatured and the nerves are cut short as before.

The wound is sutured transversely, and the cicatrix lies at the posterior aspect of the condyles of the femur.

Miller's Disarticulation at the Knee by a Circular Incision.—With the knee fully extended, a circular incision is carried around the limb at a distance below the joint line equal to two-thirds the antero-posterior diameter of the knee.

The superficial tissues are raised until the joint line is exposed, and disarticulation is carried out as already described.

This is a simple and satisfactory operation and may be executed with rapidity. When the knee-joint is in the attitude of full extension the skin on its anterior aspect is relaxed, while that behind is tightly stretched. Accordingly, when a circular incision is made as above, little retraction takes place in front, but the retraction behind is so free that the same result is achieved as though an elliptical incision had been made with its lowest point anteriorly. The cicatrix will lie transversely on the posterior aspect of the stump as in the preceding operation.

AMPUTATIONS THROUGH THE THIGH.

Carden's Transcondyloid Amputation.—In this procedure a large flap consisting of the superficial tissues is raised from the front of the knee, and the femur is divided just above its articular surface; the patella is also removed. The operator standing at the right side of the limb marks out a broad anterior flap, which has its extremities over the most prominent part of each condyle, and the summit of its convexity at the lower border of the tibial tubercle.

The posterior cutaneous incision crosses the popliteal surface with a slight downward convexity.

With the knee extended, the anterior flap is raised as far as its base.

The tissues at the back of the joint are divided transversely at the level of the retracted skin.

In front the quadriceps muscle is divided at the upper border of the patella until the supra-patellar synovial pouch is exposed. The synovial membrane beneath the quadriceps muscle is dissected away from the muscle and from the front of the femur down to its trochlear surface. All the remaining tissues covering the lower extremity of the femur are now divided and the way is prepared for the bone section.

With the limb held horizontally and the tissues carefully retracted, the saw-cut is made through the femoral condyles. A narrow-bladed saw is best suited for this purpose, so as to make the section slightly curved from before backwards, concentric with the femoral articular surface.

The popliteal vessels are ligatured, and the popliteal nerves are cut short. The tourniquet is then removed, and any additional vessels requiring ligatures are secured.

The anterior flap is folded back, and the sutures are introduced. Drainage had better be provided for during the first twenty-four hours. Lord Lister modified Carden's amputation in the following way: The lower limit of the anterior flap is marked by a transverse incision at the mid-point of the ligamentum patellæ. The posterior incision describes a downward curve, so as to map out a short posterior flap. The muscular tissues are divided and the bone section made as before.

Gritti's Transcondyloid Amputation.—In this operation the femur is divided transversely immediately above the condyles, the cartilaginous surface of the patella is removed, and in the subsequent osteoplastic procedure the cut surfaces of the patella and femur are brought into apposition and securely fixed with the object of obtaining direct bony union.

A large U-shaped incision is outlined in front of the knee, its extremities reach to a point just above the most prominent part of the femoral condyle on each side, and its summit crosses the ligamentum patellæ close to its tibial attachment. The extremities of this incision are connected behind by another incision, which crosses the popliteal space with a slight downward convexity.

In raising the anterior flap the ligamentum patellæ is exposed and divided, the patella is thus taken up also, and the flap is reflected up to its base.

Posteriorly the superficial tissues are raised for a short distance, and the remaining structures are divided down to the bone.

Disarticulation is now effected by dividing both the extra- and intra-articular ligaments.

The femur is sawn across transversely immediately above its articular surface.

The cartilaginous surface of the tibia is next removed, the bone being held meanwhile in a lion-forceps grasped in the left hand.

The main vessels are ligatured, and the nerves are cut short as before.

The patella may be maintained in contact with the femur by sutures of silver wire, or, perhaps better still, by an ivory peg, one end of which is left projecting and is included in the dressings for about ten days, after which the peg may be removed.

The large anterior flap is sutured posteriorly, and a drain is introduced for twenty-four hours.

Stokes's Supracondyloid Amputation.—In the procedure of Gritti just described considerable difficulty may be experienced in bringing the patella into apposition with the sawn surface of the femur in consequence of the traction exerted by the quadriceps muscle. Subsequently contraction and retraction may cause displacement of the patella forwards, its superior border being at the same time pulled upwards, so that the bone assumes an oblique position, which interferes with the utility of the stump. In Gritti's operation, too, there is considerable disparity between the cut surfaces of the femur and patella. To overcome these objections the following modification of it was devised by Stokes :

The cutaneous incision is elliptical, having its highest point behind opposite the upper level of the condyles, and its lowest point anteriorly over the middle of the ligamentum patellæ.

The flap thus outlined is raised, together with the patella.

Disarticulation is now performed as before.

The femur is sawn across immediately above the condyles, the articular surface of the patella is removed, and the operation is completed as in Gritti's procedure.

The resulting stump is very good, and it is well adapted to sustain the superincumbent weight.

Amputation through the Thigh by a Long Anterior Flap.—The patient is so placed that the buttocks lie close to the end of the table, the thigh and leg projecting beyond it. The operator stands to the right of the limb, which is held and suitably manipulated by an assistant as the amputation proceeds (Fig. 32).

Hæmorrhage is controlled by an Esmarch's tourniquet applied in a figure-of-eight manner around the pelvis and the upper extremity of the thigh, compressing the femoral artery against the brim of the pelvis. A firm pad is applied beneath the tourniquet over the line of the artery. If the amputation is performed through the lower part of the thigh the tourniquet may be applied to the limb circularly just below the fold of the groin.

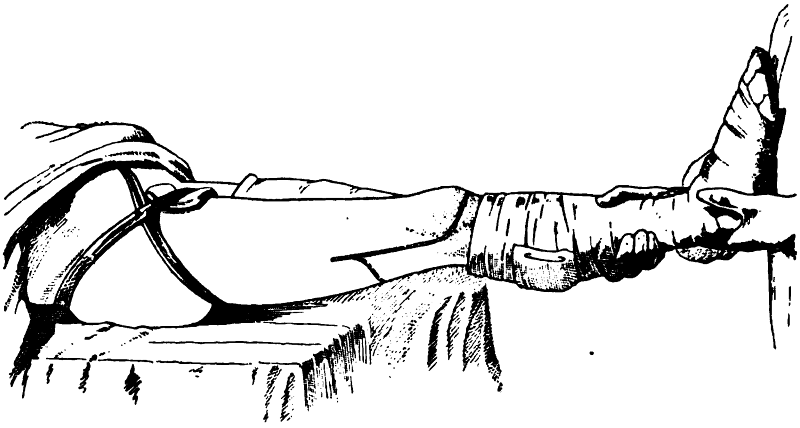

FIG. 32.—Amputation through the lower part of the thigh by a long anterior flap. The cutaneous incisions (E: H. T.).

The Large Anterior Flap.—In the lower segment of the thigh this flap is raised from the antero-external aspect of the limb; this arrangement ensures that the femoral artery is retained in the posterior flap, and prevents the vessel from being split longitudinally when the anterior flap is being raised.

The length of this flap is equal to the antero-posterior diameter of the limb at the level of the bone section, and it is fashioned as follows: Having taken the necessary measurements the operator commences the incision on the opposite side of the limb and a short distance below the site selected for the saw-cut, and carries the knife with a sawing movement first downwards, then across the front of the limb, and finally upwards on the side next to him to a point exactly opposite to that from which he started.

The incision indicating the posterior flap is made by connecting the two limbs of the incision just made across the back of the thigh so as to outline a flap about a third the length of the anterior. In raising the large anterior flap the superficial tissues are first detached, and then the muscular strata are incised to a progressively deeper extent until all the tissues in front of the shaft of the femur are included in the flap by the time its base is reached (Fig. 33).

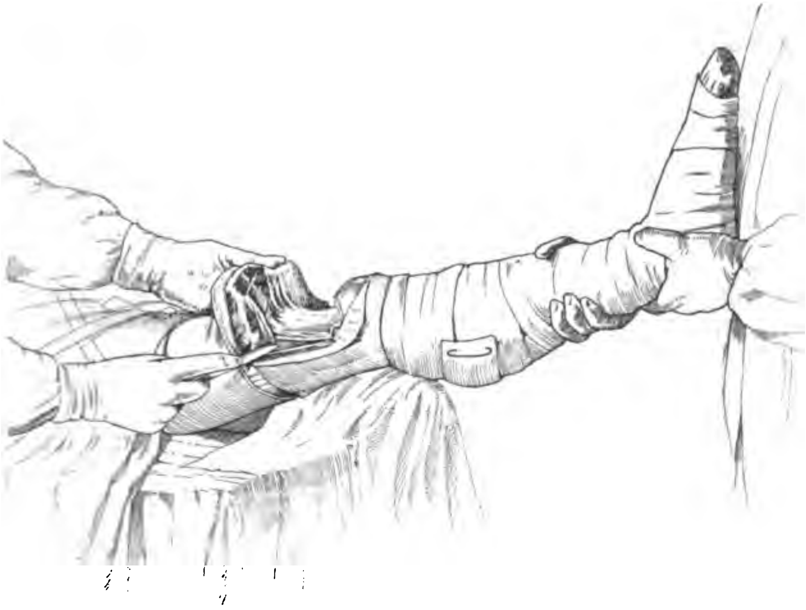

FIG. 33.—Amputation through the lower part of the thigh by a long anterior flap. Method of reflecting the flap. (E. H. T.)

The muscles at the back of the thigh are divided transversely at the level of the retracted skin.

The femur is cleared all round up to the required level, and the tissues are carefully drawn aside by means of a two-tailed retractor (Fig. 34). The bone section is then made, and as this is being done the limb should be carefully steadied so as to prevent the bone from being splintered.

The femoral and profunda vessels are ligatured and the great sciatic nerve is cut short. As this large nerve trunk is often accompanied by an arterial branch of some size it is desirable to secure it, if possible, before dividing the nerve. Having removed the tourniquet the flaps are again inspected and any obvious vessels requiring ligatures are secured.

The flaps are now brought together by a few deep sutures of stout silkworm gut, and the cutaneous margins are adjusted by a fine continuous suture of silk or linen thread. A drainage tube is introduced between the flaps at the outer extremity of the stump.

Comments.—This amputation is eminently adapted for all parts of the thigh.

The anterior flap should be made broadly U-shaped. There is a tendency on the part of beginners to make it too pointed.

The hamstring muscles at the back of the thigh are divided long, so that the amount of the retraction which takes place may be limited. If these muscles are divided at too high a level there is a risk of the stump assuming a conical shape.

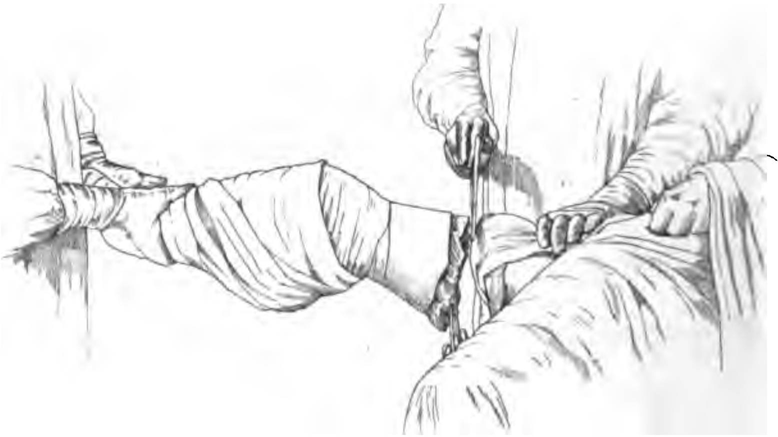

FIG. 34.—Disarticulation at the hip-joint by a modification of the method of Furneaux Jordan. Section of the femur. Observe the fingers of an assistant exerting direct pressure upon the common iliac artery through an abdominal wound. (E. H. T.)

DISARTICULATION AT THE HIP-JOINT.

Indications.—The following are the chief conditions which indicate disarticulation at the hip-joint: Severe injuries in which the tissues of the limb are irretrievably damaged ; extensive necrosis or disease of the femur ; some cases of malignant disease ; occasionally extensive tuberculous disease of the hip-joint involving the acetabulum.

Control of Hæmorrhage.—A great many methods have been employed for preventing loss of blood during the operation. The following appear to be most deserving of mention: (*a*) The abdominal aorta is compressed just before its bifurcation by an assistant, who, standing well over the patient, presses against the abdominal parietes with his closed fist at a point just below and to the left of the umbilicus (MacEwen); (*b*) the common femoral artery may be controlled by digital compression against the brim of the pelvis but this method is not reliable; (*c*) an Esmarch's elastic

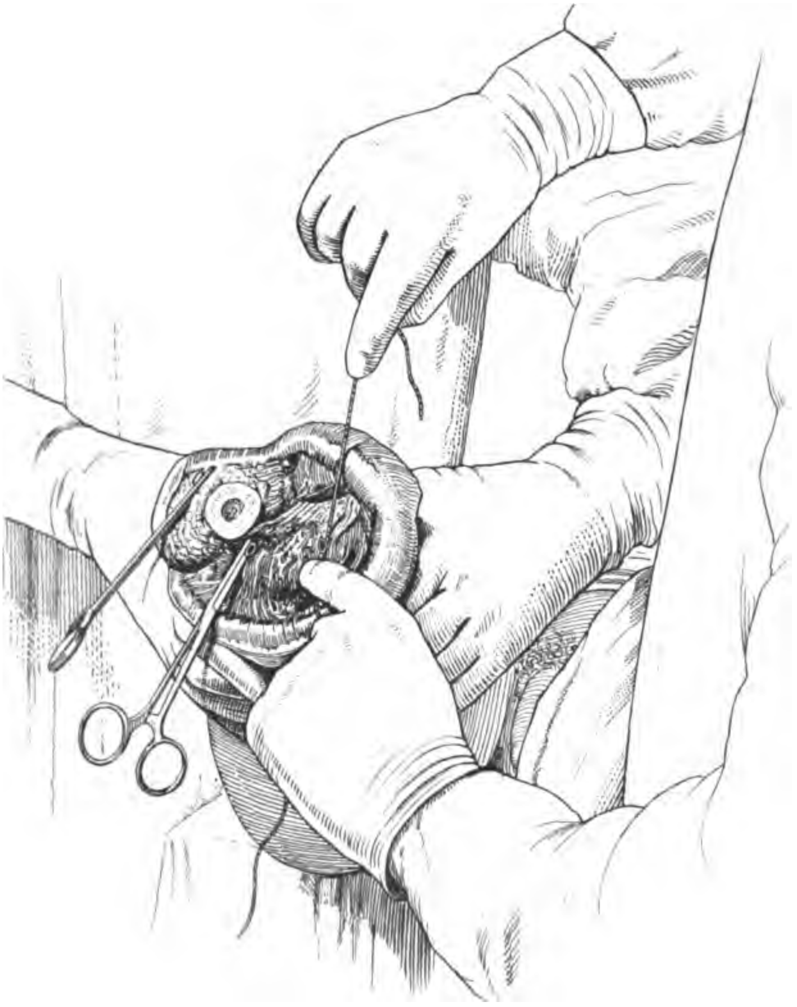

FIG. 35.—Amputation through the thigh. Application of a ligature to the femoral vessels. (E. H. T.)

tourniquet may be applied to the pelvis and the root of the thigh in a figure-of-eight manner, as in amputations through the upper part of the thigh (Fig. 32); (*d*) the common iliac artery may be controlled by direct digital compression through an incision in the abdominal parietes. The incision is made at the outer border of the rectus muscle below the level of the umbilicus. The intestines are turned aside, or they may be displaced upwards by making use of the Trendelenburg position: this manœuvre will also aid in emptying the limb of blood, in diminishing the amount of venous bleeding and in circumventing shock. The pulsations of the artery will be felt as it lies at the inner border of the psoas muscle, and it may be compressed against the body of the fifth lumbar vertebra. The ureter crosses the vessel close to its bifurcation, and should, if possible, be protected from pressure; (*e*) the main vessels may be exposed and divided between ligatures at the commencement of the operation. In its later stages arteries of smaller size are secured as they are divided. This method of controlling hæmorrhage is best adapted for cases in which disarticulation is performed by means of an anterior racket incision.

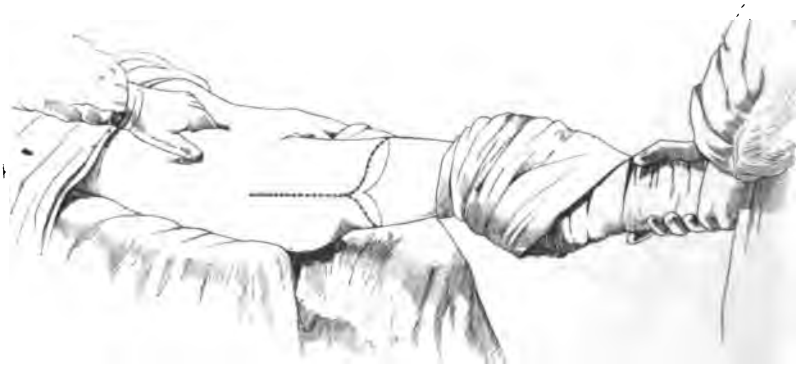

FIG. 36.—Disarticulation at the hip-joint. The cutaneous incisions are represented by the dotted line. The fingers of an assistant introduced through an abdominal wound control the common iliac artery. (E. H. T.)

Furneaux Jordan's Method of Disarticulation Modified.—The hip on the affected side is brought well over to the edge of the table and the lower limb projects beyond the table, being held by an assistant. The surgeon stands at the right side of the limb.

The disarticulation is effected through a racket incision; its vertical limb is on the outside of the limb and its circular segment extends around the thigh near the junction of its upper and middle thirds. At this level it will usually be most convenient to perform a circular amputation, and subsequently to remove the upper extremity of the femur by means of a subperiosteal resection.

The stages of the disarticulation are as follows: The circular portion of the incision is first marked out at the selected site, and for convenience in dissecting back the superficial tissues a notch is made on each side so as to fashion two short flaps.

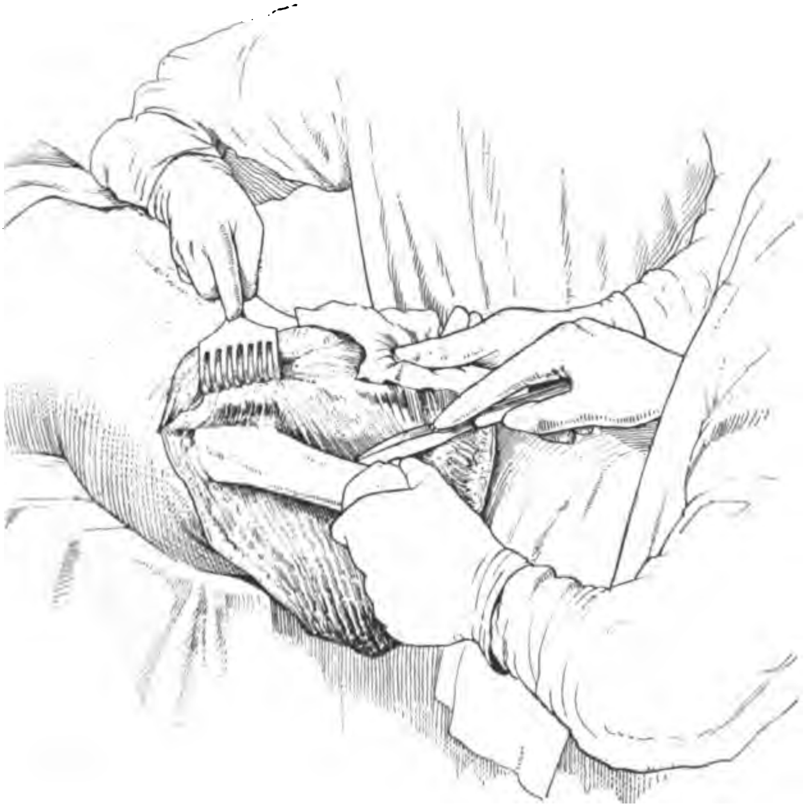

FIG. 37.—Disarticulation at the hip-joint by a modification of the method of Furneaux Jordan. The upper extremity of the femur is being stripped of its investing tissues before effecting the disarticulation. (E. H. T.)

Having turned back the superficial tissues for a couple of inches the sartorius muscle is identified and divided, whereupon the femoral vessels are exposed and divided between ligatures. All the remaining tissues are now divided circularly to the bone at the level of the retracted skin and bleeding vessels are secured. Retractors are applied and the femur is sawn across. If a figure-of-eight tourniquet has been applied it may be removed at this stage.

The next step consists in making the vertical limb of the incision. It extends from a point two inches above the summit of the great trochanter along the mid-lateral line of the limb to the notch at the outer part of the circular incision. All the tissues are divided down to the bone, and the subtrochanteric segment of the femur is cleared subperiosteally (Fig. 37).

The muscles attached to the great trochanter are now divided, viz., the gluteus medius, gluteus minimus, pyriformis, obturator externus, obturator internus, and the gemelli. The ilio-psoas muscle is detached from the small trochanter. These sections are facilitated by rotating and manipulating the bone so as to render the various muscular attachments accessible to the knife.

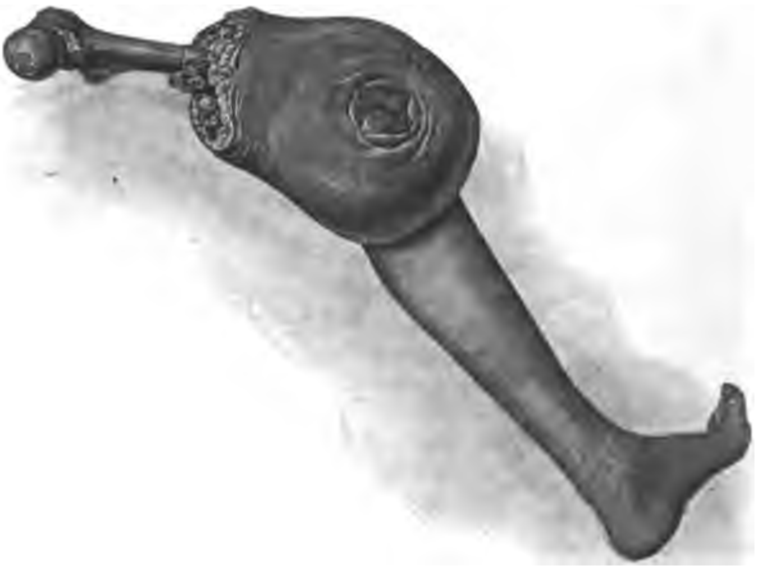

FIG. 38.—Limb removed on account of a large osteo-sarcoma of the lower extremity of the femur. The patient continues well six years after the operation. (E. H. T.)

Disarticulation is effected as follows: The joint capsule is freely divided by cutting against the neck of the femur, the bone being suitably rotated meanwhile. The cotyloid ligament must be divided also by directing the cutting edge of the knife inwards against the rim of the acetabulum. The surgeon now grasps the femoral shaft, and having abducted and rotated it outwards he presses it backwards with considerable force so as to make the head of the bone project forwards and leave its socket. The ligamentum teres is divided, and after a few additional strokes of the knife through the tissues at the back of the joint the bone is removed.

Any vessels which may require ligatures are now attended to, and the great sciatic nerve is cut short.

The deeper muscular strata may be connected by a few buried sutures of catgut. The skin margins are brought together, and the large wound is regularly spaced by a number of interrupted sutures of silkworm gut. These are supplemented by a continuous suture of fine silk or linen thread.

A drainage tube is inserted down to the acetabulum through the upper part of the vertical incision.

Comments.—The results of this operation are good. The muscles may be divided as low as may be desired, and a good covering is provided for the tuber ischii, through which the weight of the body is mainly transmitted to the artificial limb.

Subperiosteal resection of the upper part of the shaft of the femur is of advantage, as the resulting stump is much firmer and more movable than that left after removal of the periosteum. Of course, if the periosteum is diseased or involved in a new growth, it must be sacrificed. Before any attempt is made to effect disarticulation the cotyloid ligament should be divided.

Disarticulation at the Hip-joint by an Anterior Racket Incision.—In this operation the stem of the racket incision is in front over the femoral vessels, and that part which encircles the limb is lanceolate rather than circular in outline.

The attitude of the limb being as in the preceding operation, the incision is commenced in front over the centre of Poupart's ligament. It is carried downwards for 3 or 4 inches, and then inwards over the inner aspect of the thigh and backwards to its posterior surface. Finally, it is prolonged outwards to reach the external aspect of the limb, across which it slopes with a slight curve to its termination in front in the lower extremity of the vertical limb.

The incision is deepened below Poupart's ligament, the femoral vessels are isolated, and both the artery and vein are divided separately between ligatures. The superficial tissues are reflected for a short distance all around, and the section of the muscles is commenced at the level of the retracted skin. The anterior aspect of the joint is now exposed and the capsule is divided; the cotyloid ligament is divided also by directing the incision upwards until stopped by the bony rim of the acetabulum. The assistant, who holds the limb, now flexes and abducts the thigh, and at the same time by carrying the limb backwards makes the femoral head project forward and leave its socket.

The muscles attached to the trochanters are divided close to the bone, and after a few additional strokes of the knife posteriorly the limb will be found free.

Branches of the gluteal and sciatic arteries will require to be ligatured in the posterior part of the wound.

The wound is closed in the usual way, viz., by introducing a series of deep, interrupted sutures, and supplementing these with a continuous suture of fine thread in order to ensure accurate coaptation of the skin margins. A drainage tube is introduced and its free end brought out at the posterior extremity of the wound.

Comments.—In this operation the soft tissues are divided at a high level, and consequently it is a useful procedure when it is required for disease which has invaded the upper part of the thigh.

The joint capsule is clearly exposed, and disarticulation is effected without difficulty.

E. H. TAYLOR.

INJURIES AND DISEASES OF THE HEAD.

INJURIES OF THE HEAD.

INJURIES OF THE SCALP.

Contusions of the Scalp.—Contusions of the scalp are more or less extensive according to the degree of violence producing them. Slight trauma causes only a laceration of the subcutaneous connective tissue, with greater violence the subcutaneous tissue and the aponeurosis are involved, and, with a further degree, the skin covering along with the underlying layers exhibits a contused wound. In nearly all scalp wounds the aponeurosis is lacerated. Contusion of the scalp is usually associated with hæmatoma, and the collection of blood may be situated under the skin, under the aponeurosis, or under the periosteum. Subcutaneous and subaponeurotic hæmatomata usually, however, co-exist.

A simple subcutaneous hæmatoma forms a rounded doughy swelling in the movable scalp. Such hæmatomata disappear rapidly and rarely suppurate. Their treatment consists in shaving the area of the scalp concerned, cleansing the skin with alcohol (70 per cent.) and applying light pressure. If suppuration should occur, incision becomes necessary.

Subaponeurotic hæmatomata form soft rounded swellings which may be plainly visible if the hair is scanty. They present a fluctuating centre and a firm raised edge, which is formed of coagulum. This edge may lead to the suspicion of a depressed fracture, but when firm pressure is made upon it with the finger the elevation, if formed of coagulum only, is dissipated. It is then demonstrable that the bone within and the bone without the ridge are on the same level.

Subaponeurotic hæmatomata often disappear very slowly. In the great majority of cases the only treatment that is necessary is cleansing of the overlying skin by shaving and the application of alcohol (70 per cent.). This cleansing should be followed by moderate pressure by means of a pad of aseptic wool and bandage. If cleansing of the scalp is not attended to suppuration may follow, the infection spreading from abrasions in the overlying skin. If suppuration is shown to have occurred by pain and tenderness in the swelling and increased heat associated with pyrexia, it is necessary to incise without delay. Such an incision should be made in a direction parallel to that of the main vessels of the region, and should be of sufficient size to provide free drainage by means of a drainage tube of fair calibre. If the suppurating hæmatoma is of a large size, more than one incision may be necessary, their position being chosen so as to provide dependent drainage in the recumbent posture.

Subperiosteal hæmatomata are uncommon. If they persist beyond a period of three weeks a small incision should be made at the margin and the blood evacuated. If a subperiosteal hæmatoma suppurates, incision displays an area of exposed bone which ends in an exfoliation from the external table of the skull. That such exfoliation is about to occur will be demonstrated by the persistence of rough denuded bone at the base of the wound. Free drainage must be provided until the sequestrum has separated.

It is rarely necessary or wise to irrigate a suppurating hæmatoma of the scalp. Gauze "drainage" is only mentioned to be condemned.

Wounds of the Scalp.—Wounds of the scalp are remarkable for their tendency to profuse hæmorrhage and for the readiness with which they heal under favourable conditions. Punctured wounds, incised wounds and contused wounds require alike the greatest care in the prevention of infection, the consequences of which may seriously endanger life.

The first requirement in treatment is the arrest of hæmorrhage, the second cleansing. *Hæmorrhage* occurs from the vessels in the superficial layers of the scalp and therefore from the edges of the wound. The arteries retract on section and cannot easily be ligatured over forceps. It is best therefore, when the source of the hæmorrhage has been located, to arrest it by everting the edge of the wound, and passing a catgut suture on a curved needle around the bleeding point, avoiding penetration of the skin and tying beneath. This is only necessary when an artery of considerable size has been severed. When hæmorrhage is only moderate the bleeding points should be seized with artery forceps which remain on while the wound is being cleansed. They are removed after the sutures have been passed, and tying of the latter completes the hæmostasis. The first step towards *cleansing* is the shaving of the hair over a considerable area around the wound. This area is then washed thoroughly with soap and a gauze swab, followed by alcohol.

The edges of the wound are then everted and a careful examination is made first for the presence of foreign matter and secondly to decide the question whether the wound is complicated by fracture.

For the cleansing of the wound itself no agent is so useful as peroxide of hydrogen ("Sol. hydr. perox. 10 vols." 10 per cent. in water). Irrigation with this solution aids in the removal of foreign matter, which is further effected with gauze and dissecting forceps. The wound having been thus treated, it remains to suture it. Interrupted sutures of silkworm gut are used for this purpose, and they should include the aponeurosis when this has been severed.

When the edges of the wound are much contused it is a useful plan to dab the suture line with tincture of iodine before applying the dressing. Drainage is only necessary when (*a*) a considerable area of scalp has been separated, or (*b*) when disinfection is doubtful.

These scalp wounds usually heal readily. Should infection follow it may be limited to a small area or may spread widely over the head, in which case pus may collect in large quantity under the aponeurosis. In either case ample drainage must be provided, through the wound in limited infection and by supplementary incisions in widespread suppuration.

For the proper cleansing of a scalp wound it is usually necessary to administer a general anæsthetic.

Punctured wounds which form a long track must be opened up by incision in order to cleanse them properly.

Avulsion of the Scalp.—This accident is complete or incomplete. In complete avulsion of the scalp, that is to say, when a portion or the whole of the scalp is entirely detached, it is useless to replace it. The denuded area becomes covered with granulations and the process is encouraged by the application of wet sterile gauze dressings, changed twice daily. When granulations cover the surface epithelial grafts are to be placed thereon. Without epithelial grafting healing is very prolonged. When the scalp, or a portion of it, is incompletely detached, it should be replaced and sutured. The vitality of the detached area depends upon the blood supply through the pedicle. It is necessary to expend much time on cleansing the whole region, and drainage is advisable by means of small rubber tubes. The dressing is dry sterile gauze and the tubes are removed in forty-eight hours if the wound is healthy. It is necessary to keep a careful watch for suppuration under the detached portion.

INJURIES OF THE SKULL.

Fractures of the skull are usually complicated by injuries to the cranial contents, injuries which produce the phenomena described as concussion and compression. These complications are discussed elsewhere, and in this section attention will be confined to the treatment of the fracture itself.

Fractures of the vault of the skull, if simple and uncomplicated, are difficult of diagnosis unless there is deformity. As a fracture of this type requires no treatment, this difficulty is of no moment.

In compound fractures the extent of the bone lesion can be examined. The first step in treatment is the thorough cleansing of the wound after the method laid down for scalp wounds, and this is the only treatment necessary if the fracture is uncomplicated. Whether drainage is necessary will depend on whether the surgeon is confident that the wound has been rendered aseptic. It is better to err on the safe side and employ drainage in the majority of such cases; infection under a closed wound is likely to lead to serious results.

When there is *depression* of fragments, whether the fracture is a simple or a compound one, measures must invariably be taken for their elevation. When there is no scalp wound the depression is displayed by a suitable incision. When the fracture is compound the wound is enlarged as far as may be necessary.

It may then prove possible to replace the depressed fragment or fragments with forceps and elevator.

If this cannot be done an opening is made through the skull at the edge beyond the depression. For this purpose a trephine of ½ inch diameter, or a drill and a cutting burr, are employed. Through this opening the elevator is passed and the fragments levered up. The dura must always be inspected and, if torn, carefully sutured with fine catgut.

If there are loose fragments the question will arise as to whether they should be removed or replaced. In a clean wound there need be no fear of necrosis, so that in simple fractures no fragment need be sacrificed.

In compound fractures each case must be considered on its merits. When foreign matter has been ground into the wound, or when the wound is much contused and lacerated, it is best to remove such fragments.

Bony defects of the skull are not usually closed by growth of new bone, but the scar tissue which forms is tough and provides a very fair protection to the cranial contents.

In simple fractures no drainage is necessary unless there is very marked oozing, in which case a fine rubber or catgut drain may be left in in one angle of the wound for 24 hours. In compound fractures a rubber drain should be invariably left in for 36 to 48 hours.

When a defect in the skull is left by an injury, the question arises as to whether any special operative measures should be undertaken to close it. The weight of the evidence is in favour of the view that such defects do not in themselves call for operative treatment. At the time of the injury the greatest possible care should be taken to remedy lacerations of the dura as the most important of all the cerebral coverings. It is certainly better also that no skull defect should remain, but, if this results, it may be left alone without fear that in itself it will be detrimental later.

Fractures of the base of the skull are frequently complicated by concussion and compression, and their treatment is for the most part that of these complications. There are, however, general therapeutic measures for all these fractures. In the first place care should be exercised in transport, as the injury may be greatly aggravated by careless movement. The patient is placed recumbent with the head moderately raised; the head is shaved and an ice cap applied. Absolute rest is ensured, an efficient aperient is given, and for the first twenty-four hours the food is to be light and very small in quantity. This last instruction must be varied according to the patient's condition. A robust man with concussion requires no food whatever during the twenty-four hours after the accident. (*See* Concussion.) Infection is a common complication of basal fractures, and measures must be taken to prevent it. In fractures which are compound into the ear, the external meatus must be cleansed. This should be done not by syringing, but by careful swabbing with wool soaked in peroxide of hydrogen solution; after this, powdered boracic acid powder is insufflated into the meatus. The nasal chambers also require attention. It is impossible to cleanse the upper part of the nasal chamber mechanically and it is inadvisable to wash it out with an antiseptic solution; it is questionable whether it is required. The anterior nares, however, should be carefully cleansed; crusts are washed away with a normal saline douche, and a light filter of dry absorbent wool is placed in each nostril. The nose does not require "plugging," and wool placed in the nostrils should be renewed frequently. Patients who have sustained a fracture of the skull need careful attention for a long period after their accident. No definite time can be stated for confinement to bed, but even in uncomplicated cases it is unwise to allow the patient out of bed under fourteen days, and this period should be treated as the irreducible minimum.

Fractures caused by Fire-arms.—The great majority of gunshot fractures of the skull seen in civil practice are caused by soft revolver bullets. The right temporal region is the common site of the wound of entry, the wound of exit, if present, being usually above the left ear, but these soft bullets often lodge. In the treatment of these accidents the extraction of the bullet is the least important of the operative indications. The missile, if left, usually becomes encapsuled, and unless it is superficial, an operation for its extraction will only add to the injury from which the patient is suffering, without really contributing towards his recovery.

The therapeutic indications are two: (*a*) The prevention of septic infection; (*b*) the relief of compression if present. The patient when first seen is suffering from concussion. The contused wound requires immediate cleansing; it should be enlarged with the scalpel sufficiently to permit of exploration with the finger. The fracture of the skull is sought, and an examination is made for loose and depressed fragments. All such should be removed. A drainage tube is then introduced down to the seat of fracture. The wound of exit is treated in the same way. The treatment of the primary lesion caused by the bullet should be limited to these measures, and no probing of the depths of the wound, with the hope of locating the bullet, should be indulged in. On the other hand, if phenomena of compression are present early, or come on later, some further operative measures are required for the relief of this complication (*see* Cerebral Compression).

INJURIES OF THE BRAIN.

Concussion, Contusion and Compression of the Brain.—These terms are employed to describe phenomena which result from injury to the cranial contents; cerebral compression occurs also from causes other than injury. They are terms which possess a certain rough and ready usefulness, enabling one to convey an approximately accurate idea of the result of an injury to the contents of the skull.

A patient may, however, present one, two or three series of phenomena, and those of concussion run without a dividing line into those of contusion, those of contusion into the signs of definite compression. As far as treatment is concerned, concussion and contusion require joint consideration. It is of importance to know whether definite gross contusion has occurred, and this can be decided by lumbar puncture. When this is demonstrated by the presence of blood in the cerebro-spinal fluid, convalescence will be more gradual, and it will be necessary to confine the patient to bed and to prohibit his return to work for a longer period than when there is reason to believe that there is no gross lesion of the brain.

A patient suffering from *concussion* with or without evidence of contusion, exhibits in the early stage a depression of all the cerebral functions. Treatment is designed on the one hand to promote the natural recovery from this depression, and on the other to prevent the onset of the more serious compression. In examining a patient suffering from concussion the first step is to determine whether the skull is fractured. If a fracture is found, treatment must be undertaken for this lesion. To remedy the concussion itself the following measures are adopted: The patient is kept absolutely at rest in bed with the head low. The head is shaved and an ice-cap is applied. The blood pressure is examined as an index of the degree of cerebral depression, and this should be estimated as accurately as possible, preferably by apparatus of the Riva-Rocci type. The pressure in the brachial artery of a healthy man is about + 110 mm. Hg. A record of 40 mm. below this should be looked upon as an indication for special measures, and in serious cases the fall is much greater. Warmth and firm bandaging of the limbs are of value; in pronounced depression, administration of saline solution per rectum should be added to these, and in the worst cases it should be given continuously. Cardiac stimulants and alcohol are best avoided, but atropin in doses of $\frac{1}{200}$ to $\frac{1}{100}$ gr. is of use, and may be repeated at intervals of six hours if the concussion is marked and persistent.

Food by the mouth should be withheld during the period of definite concussion. It is useless to put into the stomach food which it is incapable of utilising, but there is no virtue in starvation *per se*, and once signs of recovery appear an easily digested diet should be established.

The period of confinement to bed should range from two weeks upwards. An early aperient is advisable in all cases of concussion. If the cerebral depression is profound the above-mentioned restorative measures are those which should first be instituted; a suitable aperient should then be given, in the first instance calomel (5 gr.), and if this is followed by no result in eight to twelve hours, croton oil should be given in a dose of 2 or 3 minims.

During the early stage of recovery from the effects of cerebral *contusion* the patient usually exhibits the phenomena of "cerebral irritation." These symptoms may be modified by lumbar puncture. The patient is placed in the sitting posture and 20 c.c. of cerebro-spinal fluid are withdrawn from the spinal theca by inserting the needle between the third and fourth lumbar spines. This frequently has the effect of producing a condition of rest in marked contrast to the previous state of excitement and restlessness.

Compression.—Every patient who sustains a serious head injury must be watched continuously for the onset of symptoms indicating compression. It should be clearly understood that the period of onset varies with the cause. In the copious subdural effusion which follows laceration of cerebral vessels compression progresses from the commencement; in epidural hæmorrhage from torn meningeal vessels there is often a definite interval between the receipt of the injury and the onset of compression phenomena, while the compression which is due to a spreading cerebral œdema may not show itself until after the lapse of one or more days. The signs and symptoms of compression may be summarised as follows: *Prodromal stage:* Moderate stupor, headache; sometimes irritative phenomena, twitching or paresis. *1st stage:* Torpor, delirium, restlessness, venous congestion of the face, headache, slow pulse, distension of the veins of the optic disc; focal convulsive phenomena, or paresis. *2nd stage:* Deep stupor, cyanosis, slow pulse of "bounding" character, raised blood pressure, stertorous respiration; œdema of the optic disc; focal phenomena of paralytic character. *3rd stage:* Coma, irregular pulse and respiration, fall in blood pressure, universal paralysis.

In the early stage of compression the pupil becomes progressively narrowed; reaction to light gradually fails. In the later stages the pupil dilates again, and at the end is widely open. The focal phenomena above referred to may or may not be present, according to the site and type of compression.

Prompt treatment of cerebral compression will in the future save patients who have been left to die in the past; operative treatment has almost entirely been restricted to cases of meningeal hæmorrhage with a gradual onset and slowly developing train of symptoms. The compression which comes on at once from laceration of cerebral vessels and intradural hæmorrhage, and the type which results from traumatic œdema, are both also suitable for operative relief. In all three cases it is necessary to open the skull, but the details of treatment vary according to the cause of the compression.

Extradural Hæmorrhage is distinguished from other forms of hæmorrhage into the skull by the interval between the receipt of the injury and the onset of compression. It is also distinguished by the fact that it usually reveals its location by focal signs. The diagnosis may be further aided by the discovery of a fissured fracture running from the vault to the base.

When the opinion has been formed on the grounds of general and focal signs that an extradural hæmorrhage is causing compression, the skull is to be opened on its lateral aspect in the region to which the localising signs point. Cases which are treated expectantly almost inevitably end fatally. Although extradural hæmorrhage may occur in the anterior and posterior fossæ, its common site is in the middle fossa following laceration of the middle meningeal artery and its branches.

The indications as to where the skull should be opened are clear in cases of fracture with an overlying scalp wound, in other cases the focal signs give a clear guide, in the third group the operation is in part exploratory, the actual site of the compression not revealing itself by signs or symptoms. In a given case, when the site of the hæmorrhage has been determined, a large horseshoe flap is outlined with the scalpel with its attached extremity towards the base. An osteoplastic flap is then cut and reflected. Unless the wrong side of the skull has been opened the clot will be seen at once. It is cleared out with the spoon and the bleeding vessel sought. As this will usually be the middle meningeal artery, it is important to remember that the vessel branches at a point just above the centre of the zygoma and its anterior branch passes upwards to a point one inch above the zygoma and one inch behind the external angular process of the frontal bone. Once the clot has been turned out the source of the hæmorrhage may be clear; if it is not actually exposed the direction from which the blood is coming will at any rate be seen, and the bone wound is enlarged downwards or backwards until the bleeding point comes to view.

Ligatures are placed on each side of this bleeding point by passing round the vessel a curved round-bodied needle carrying silk. When there is difficulty in determining the actual point of laceration, time may be saved by ligaturing the main trunk low down. The clot having been entirely removed and the vessel ligatured the flap is replaced. It is wise to employ drainage for twelve hours. Failure to find the clot may be explained by the fact that the hæmorrhage is intradural, and not as supposed extradural, or the hæmorrhage may be extradural but situated at some other region than that exposed. If the clot is not found when the skull is opened an incision should be made through the dura mater, and if the hæmorrhage is then found, the details of treatment are those of intradural hæmorrhage as given below. If there is neither extradural nor intradural hæmorrhage in the region exposed the history and signs must be reviewed and the question considered as to the advisability of opening the skull elsewhere. Much importance will be attached to the direction of a fracture if found. If such a fracture crosses the course of one of the meningeal sinuses it would be proper to follow it to this point. If, on the other hand, there is no guide of this kind and the compression is profound, the skull must be opened in the temporal region on the opposite side. This opening is best made according to Cushing's method, for the reason that it takes less time than the cutting of an osteoplastic flap. On the other hand, the flap method is to be preferred for the primary opening, as no bone defect is left thereby.

Cushing's method consists of reflecting a flap of scalp exposing the temporal fascia; the temporal fascia and muscle are then split in the direction of the muscle fibres, the muscle is elevated from the bone, and after perforating the skull with a burr, the opening is enlarged with cutting forceps. The course of the meningeal artery is defined and followed as already described, and a ligature placed on each side of the bleeding point when found.

In rare cases there are signs of local compression without any general phenomena. For example, a head injury is sometimes followed by local paresis or paralysis without any of the signs of general cerebral compression. All such cases require operative treatment. The paralysis is unlikely to recover completely without operative removal of the clot, and even if this occur the condition is likely to eventuate in epileptiform convulsions, having their origin in the lesion caused by the unremoved clot.

Further, there are cases where slight or marked signs of local cerebral compression are unaccompanied for a period of days or sometimes two to three weeks by any signs of general compression; then suddenly general cerebral compression supervenes, and its progress is so rapid that operation can give no relief. Several well-marked examples of this course of events have recently been published, particularly in France, where the designation *compression tardive* is applied to it. These cases teach the necessity of operation in all cases in which the symptoms point to a clot pressing on the brain, however restricted the symptoms may be.

Intradural Hæmorrhage.—When cerebral compression results from intradural hæmorrhage the condition is usually much more difficult of exact appreciation, the stages, instead of forming a slow sequence, follow one another rapidly. Within an hour after the receipt of the injury, or after an even shorter period, the compression may be profound and death from this cause imminent. The reasons for this are two: in the first place, blood is rapidly effused, there being no such resistance to overcome as in hæmorrhage between dura and skull; and in the second place the medulla feels the compression early, as the collection is usually basal. The condition is a frequent complication of fractures of the skull base. Patients who have sustained this lesion often exhibit the signs of the second stage of compression when first seen, there being no history of an interval and the first stages having been rapidly passed. The pulse is slow and bounding, the respiration stertorous and rhythmic, the optic discs are œdematous and the face deeply cyanosed. Consciousness is either entirely abolished or there are alternating periods of irritability and coma.

When unrelieved the symptoms rapidly change into those of the terminal stage, the blood pressure falls and the heart's action becomes irregular, consciousness entirely disappears, the respiration becomes shallower, the pupils dilate and finally all medullary functions are suppressed. A certain proportion of these patients may be saved by prompt surgical treatment, but the attempt to rescue such a patient from the second stage of compression needs some courage and a quick decision.

The skull and dura mater must be opened with the single purpose of relieving the intracranial pressure. It is rarely the case that the hæmorrhage is so localised that any focal symptoms are present; the extravasation is usually basal and diffuse. The site of the fracture is not a matter which decides the situation for trephining as in extradural hæmorrhage; in the absence of focal symptoms the indication is to reach the base, the alternative situations being the middle and posterior cranial fossæ. The middle fossa is to be chosen for two reasons, access is comparatively easy and rapid, and the cerebral laceration from which the hæmorrhage comes is usually here. The route is through the temporal bone. An incision is made through the scalp in the temporal region from above downwards and forwards. The temporal fascia is incised in the same direction and the fibres of the temporal muscle are separated, exposing the pericranium and bone. After incising and retracting the pericranium the bone is perforated and cut away with forceps over an area about the size of a half-crown. The exposed dura mater is opened crucially and with the greatest possible gentleness the brain is elevated with a narrow spatula. Exit may be given to a basal collection and a drainage tube is inserted towards the base.

Such a case requires the greatest possible care in after-treatment.

Before commencing the operation the scalp will have been cleansed, and after the operation at every dressing this cleansing should be repeated. For the first forty-eight hours the exudation will probably be copious and the dressing will require renewal every twelve hours. Each time it is changed the area should be swabbed over with tincture of iodine. Should the patient do well the tube will remain in place about four days; after its removal the same care is exercised to prevent infection of the wound.

Cerebral Œdema.—A spreading œdema occurs in the brain as a consequence of damage to the capillary circulation. From the therapeutic point of view it is necessary to understand clearly (*a*) that it is the main factor in causing death in many cases of cerebral laceration without compression from hæmorrhage, (*b*) that it may follow a cerebral compression from hæmorrhage and may cause death after hæmorrhagic compression has been relieved.

Very commonly a patient admitted to hospital after a severe head injury recovers to a great extent from his concussion after a few hours, passes into the stage of what has been called cerebral irritation, and after a more or less lengthy period of thrashing about, relapses slowly into coma and dies. If this relapse is watched its phenomena will be found to be those of slowly advancing compression. On the other hand, cases of the following type are met with from time to time. A patient with definite compression symptoms is operated on, the clot is removed from between dura and skull, and the hæmorrhage stopped. In spite of this the patient does not make the steady progress towards recovery which is expected. After promising well he passes gradually into stupor.

In both cases cerebral œdema has supervened on the primary injury and caused progressive compression. The indication for treatment is to give the œdematous brain room to expand, in other words to open the dura mater. In cases of œdema following contusion this relief of tension must be given in the same manner as for compression from basal hæmorrhage.

When, however, it supervenes on an epidural hæmorrhage which has been removed the wound must be reopened and the intact dura incised, keeping away from the motor cortex as far as possible, particularly on the left side of the head.

The same condition may follow an unrelieved depressed fracture of the skull; the clear indication then is to elevate the depression. If this elevation is not followed by disappearance of the compression symptoms, the wound must be reopened, the bone removed and the dura mater incised.

INFECTIONS FOLLOWING HEAD INJURIES.

Meningo-encephalitis.—Meningo-encephalitis may complicate a head injury in one of two ways.

The infection may reach meninges directly through a compound fracture, or a septic infection of overlying structures, scalp and bone, may be followed eventually by extension to membranes and brain. A direct infection usually shows itself from the fourth to the sixth day after the fracture. For example, a fracture of the anterior fossa, compound into the nose, is liable to be followed by a basal meningo-encephalitis. This complication is shown by persistence of the phenomena of cerebral irritation, photophobia, fever and the gradual onset of coma. An indirect infection from a septic wound is later in development, but is demonstrated by the same phenomena.

The prevention of this complication is discussed under the headings of Scalp Wounds and Fracture of the Skull.

Once established the outlook is very serious, but operation has saved a few patients. The only operation from which any relief can be expected is the provision of drainage in the occipital region. For this purpose the skull is opened in the posterior cranial fossa on one or both sides, an incision is made through the dura mater, the cerebellum is elevated by a blunt instrument which opens the subarachoid cistern and a drainage tube is then introduced.

Cerebral Abscess.—A septic scalp wound or a septic compound fracture of the skull may be followed by a localised infection in the brain with the formation of a localised collection of purulent exudate. The development of this complication is often delayed several weeks after the initial injury. Its onset is indicated by headache, vomiting, stupidity and drowsiness, a subnormal temperature and a slow pulse, and in a large proportion of cases œdema of the optic discs.

In these traumatic cases the abscess is usually situated in the cerebral cortex immediately underlying the wound in scalp or skull, and its localisation does not therefore present difficulties. The first step in operation is the enlargement of the wound in the scalp and exposure of the dura mater either by removal of bone fragments or with the trephine. The dura mater having been incised crucially, an exploring needle with a blunt extremity and lateral openings is inserted into the cortex, and with this the collection of pus is sought. A drainage tube with two or more openings near its extremity is introduced and the dura mater is brought together around it. Care must be taken to prevent the infective pus overflowing into the subdural space by placing a strip of gauze packing around its point of exit from the cortex.

The abscess cavity usually closes up rapidly; its drainage is conducted on general principles, the tube being gradually withdrawn.

HEAD INJURIES IN THE INFANT.

Cephalhæmatomata in the infant are effusions of blood beneath the pericranium. They are confined to the limits of single bones by the attachment of the pericranium at the sutures and are most common in the right parietal region. They usually increase in size after birth, reach their maximum at the end of the fourth or fifth day, and begin to subside during the second week.

A cephalhæmatoma which follows this course requires no surgical treatment.

When there are no definite signs of absorption in the third week the blood should be evacuated through a small incision at the margin after careful preparation of the scalp. It is useless to try and evacuate such collections with a trocar or an exploring needle.

Fractures and indentations of the cranial bones are caused by the compression of instruments in difficult labour. Fractures usually result only when extreme violence is necessary, and are almost always associated with such cerebral injury that the child does not survive. Depressions are more common; they do not require immediate treatment, and often disappear spontaneously in the course of a few weeks. If the indentation persists beyond a period of from three to four weeks operation is necessary. An incision is made at the edge of the depression and a blunt instrument introduced beneath it. Elevation is usually easy.

Intracranial Hæmorrhage occurs from violence to the head of the infant during labour. The common source of the hæmorrhage is cerebral venous channels and the usual situation is the vertex. According to the degree of extravasation there is damage to the underlying cerebral cortex, and the typical late result is spastic paralysis or "Little's palsy." The early phenomena are, shallow and irregular respiration and irregular pulse, torpor, distension of the fontanelles, convulsions or simple convulsive movements of the limbs.

The condition is difficult to recognise in the early stages and it is only at this period that surgical treatment is advisable. If the lesion is recognised during the first week of life the clot should be removed by operation. Experience of the value of this operation is at present small, but it has shown that the infant tolerates the operative procedure remarkably well, and that complete recovery may be anticipated in from one third to one half of cases. If the pressure of the clot is unrelieved and the child survives, he grows up a paraplegic and often mentally defective.

K. W. MONSARRAT.

INFECTIVE LESIONS OF THE SCALP AND CRANIUM.

INFECTIVE LESIONS OF THE SCALP.

These infections may be localised or generalised.

The Localised Infections are represented by furuncle, anthrax and circumscribed abscess. The treatment of furuncle and anthrax differ in no particular from the treatment of the same conditions elsewhere.

Circumscribed abscess may be sub-cutaneous or sub-pericranial. The latter is a collection of pus, usually limited in extent to the surface of a single bone, and often secondary to osteomyelitis. The treatment of the former differs in no respect from the treatment of similar conditions elsewhere.

The treatment of sub-pericranial abscess will be determined by the underlying cause. When secondary to osteomyelitis, its treatment will be directed to the primary condition.

Carbuncles occur frequently on the occipital portions of the scalp, though they are more frequent on the neck below the hair margin. Bier's hyperæmia treatment may be used in the early stages, but the most satisfactory treatment is by complete and early extirpation. The urine should always be examined in these cases with a view to ascertaining the presence or absence of sugar.

Generalised Infections of the Scalp are represented by erysipelas and diffuse cellulitis of the sub-aponeurotic layer.

Erysipelas being usually a self-limited disease, the treatment is largely a constitutional one. Cooling antiseptic lotions give comfort locally. The use of anti-streptococcic serum has proved of questionable advantage. Bier's treatment may be tried with advantage.

In sub-aponeurotic abscess the infection, confined in the loose sub-aponeurotic space, may spread over the entire scalp. In such cases counter-openings for drainage should be made round the dependent parts of the scalp. Freqent cleansing irrigations and fomentations are necessary. If the underlying bone becomes infected, the resulting osteomyelitis may extend to the diploë and inner table, and larger sequestra may be separated off. Should osteomyelitis supervene, it must be treated on the lines laid down under that condition.

INFECTIVE LESIONS OF THE CRANIUM.

Acute periostitis is common in open infected wounds, and also after contusions. The treatment should be directed to the disinfection of the wound, with free drainage to avoid the retention of septic material under tension.

Acute osteomyelitis of the skull is a rare affection as a primary process. The affection is one of great gravity, and requires energetic and early surgical intervention. An attempt should be made to establish an exact diagnosis as early as possible, which, however, is not always an easy matter. The aim of operation should be to evacuate the purulent focus and to resect all of the infected bone. A simple trephining is not sufficient. It is necessary to resect beyond the limits of the diseased bone; in other words, until sound tissue is reached. Unless this be done the condition becomes a chronic one, associated with fistulæ and prolonged suppuration. The resection may be done with a gouge and mallet, or with bone-cutting forceps after a preliminary trephining.

Traumatic osteomyelitis may be secondary to an infected wound of the pericranium, or may follow an injury to the skull without any solution of continuity of the integuments. In these cases it is not sufficient to simply open the abscess; this step must be followed by trephining and resection of the infected bone. One should not wait for the spontaneous separation of the necrosed bone, but, after enlarging the fistulous opening by a large incision, the sequestrum should be detached by the usual means, the wound carefully curetted and left open to obtain healing from the bottom. If the necrosis is very superficial it may be safe to wait for the spontaneous separation of the sequestrum; but suppuration in such a position is always dangerous, owing to the close proximity of the subjacent meninges.

The treatment of osteomyelitis secondary to suppurative otitis and sinusitis concerns the treatment of the original disease which is treated of elsewhere. Briefly the curative treatment consists of free intervention for the purpose of resection of all the affected bone, care being taken to pass well beyond the limits of the disease.

Tuberculous osteitis of the skull occurs in two forms: the so-called perforating tuberculosis of Volkmann, and the infiltrating tuberculosis. The former is the more frequent and is characterised by the formation of sequestra and of perforation of the bones of the skull. The infiltrating form is rare: as described by Koenig, it is characterised by the spread of the tuberculous lesion over a large surface of the skull and by the formation of foci of tuberculous granulation tissue between the dura mater and the bone.

The local treatment consists in as complete eradication of the disease as possible, care being taken to pass widely beyond its limits. The abscess should be exposed, its contents evacuated, and its walls extirpated: the sequestra should be removed. If a perforation of the bone has occurred, it should be enlarged and the bone resected until healthy tissue is reached. Any granulation tissue lying between the dura mater and the bone should be curretted away; the wound should then be plugged and healing allowed to take place by cicatrisation. Should the underlying dura be infected, it should be resected. Treatment should be directed to the constitutional condition of the patient along the usual well-recognised lines. In some cases cure is only obtained after several operations, so that it is well to warn the patient of the possibility of recurrences.

Cranial syphilis may be the manifestation of the acquired disease or of the hereditary form. In acquired syphilis a periostitis is met with in the secondary period analogous to the same condition occurring in the tibia and elsewhere. This form of secondary periostitis easily yields to appropriate treatment.

During the tertiary period syphilis of the skull manifests itself as a diffuse or circumscribed lesion, and is associated with necrosis and perforation of the bone or with hyperexostosis. The bones of the vault affected are, in order of frequency, frontal, parietal, temporal and occipital.

Cranial lesions in hereditary syphilis take the form of ulceration or the formation of osteophytes.

In the great majority of cases mercurial treatment will produce a cure. In order to obtain good results it is best to give intramuscular injection of the salts of mercury. If the bony lesion is not too far advanced, and constitutes simply an osteitis without the production of sequestra, cure can be rapidly obtained without having recourse to surgical measures. If the bony lesion is more advanced with the formation of a sequestrum, surgical intervention is indicated. Doubtless small sequestra can be spontaneously eliminated, but, owing to the sclerosis of the surrounding tissue, this is a slow process: moreover suppuration may supervene. In these cases surgical intervention is indicated to remove the sequestrum. Should the surface of the dura mater be affected, it may be excised or left to recover under anti-syphilitic treatment. Operation alone must not be relied upon to cure the condition. Anti-syphilitic treatment must be instituted and followed regularly for a long time.

In the form associated with exostosis, surgical treatment can be undertaken for the removal or reduction in size of the bony prominences. If the exostosis develops on the endocranial side of the bone, symptoms of nerve irritation and cerebral compression may arise. The localisation can be established by cranio-cerebral topography, or by radiography. Craniectomy may be called for to relieve symptoms due to an exostosis on the internal face of the bones of the skull.

Combined medical and surgical treatment in the case of cranial syphilis give rise to excellent results even in the severest cases.

Actinomycosis of the skull, as is the case with other bones, is usually secondary. The brain is usually attacked at the same time as the skull. The cranio-cerebral lesion is the result of a direct propagation starting from the cervico-facial focus. Cases have been reported of actinomycosis affecting the brain and skull secondary to a temporo-maxillary actinomycosis. Such cases are of the very greatest gravity, but fortunately they are extremely rare. The treatment is the same as that given for actinomycosis in other parts of the body.

DONALD ARMOUR.

TUMOURS OF THE SCALP AND CRANIUM.

CYSTIC TUMOURS OF THE SCALP.

Cystic tumours consist of three varieties: Sebaceous cyst, dermoid cyst and hydatid cyst.

Sebaceous cysts should be removed either by dissection or by transfixion. The operation can be very well done under local anæsthesia. Whichever method is adopted, care should be taken to see that the entire cyst-wall is removed to prevent recurrence. Care should be taken not to seal the incision too tightly, as infection of the wound is common.

Sebaceous cysts are subject to two complications:—suppuration and epitheliomatous degeneration. When the cyst has suppurated it should be treated as an ordinary abscess. It is rare for the suppurative process to destroy or to cure the cyst. This re-forms unless the wall has been removed. Should epitheliomatous degeneration take place, total extirpation of the ulcer, together with the neighbouring lymphatic glands, should be undertaken at once.

Dermoid cysts should be removed early in life, otherwiſe they give rise to pressure deformities in the neighbouring bone. Care should be taken not to open the dura.

Hydatid cysts of the scalp are extremely rare, although cases have been reported where they have occurred in the substance of the temporal muscle. Their treatment is the same as that for hydatid cysts elsewhere.

SOLID TUMOURS OF THE SCALP.

Solid tumours consist of two varieties: Epithelial warts and epitheliomata, and connective-tissue tumours: lipoma, fibroma, sarcoma, chondroma and osteoma.

Warts may be removed by the thermo-cautery, by chromic or acetic acid, or they may be extirpated with the knife.

Epitheliomata of the scalp should be treated by excision, together with removal of the neighbouring lymphatic glands, whether enlarged or not. Should the growth be too extensive for removal in this way, the tumour may be destroyed either by the thermo-cautery or by caustics. Radio-therapy may also be tried both for extensive growths and for those which have recurred. If the underlying bone is affected, a wide resection in its entire thickness, even though it may appear to be only superficially affected, is indicated. If the tumour has invaded the meninges and brain it should be treated in the same way as a cerebral tumour.

Lipomata are easily excised if troublesome. When their adherence to the bone shows them to be periosteal lipomata it will be necessary to remove the portions of periosteum to which they are fixed.

Simple fibromata of the skull are extremely rare and should be treated by extirpation.

Neuro-fibromatous tumours should be treated by extirpation, which should be as complete as possible. This may present difficulties in certain cases on account of the size of the tumour, and it may necessitate the removal of a portion of the scalp. On account of the large vessels contained in the tumour, hæmorrhage may be severe. When the operation has been complete recurrence is the exception.

Lymphangiomatous tumours should be completely removed.

All forms of **sarcoma** occur in the scalp. The only treatment is as early extirpation of the tumour as possible. Should the growth have invaded the bone, this also must be removed thoroughly. The extent and size of the tumour may, however, be a counter-indication to operation.

Chondromata and osteomata may be removed if giving rise to symptoms.

Cheloids are common upon the scalp, especially in the suboccipital region, frequently arising in the scars of old furuncles. They should on no account be excised. Injections of fibrolysin may be tried, or they may be treated with the X-rays.

VASCULAR TUMOURS.

The vascular tumours met with in the scalp are angiomata, and various forms of aneurysm and nævi.

The treatment of **angiomata** varies according as to whether the growth is circumscribed or diffuse. Circumscribed angiomata may be treated by extirpation. When diffuse, they may affect the region so extensively as to be impossible of removal. Recourse may then be had to cauterisation, injections, electrolysis or radio-therapy.

Simple aneurysms are usually small and of traumatic origin; they may be readily and safely extirpated.

Arterio-venous aneurysms should be treated, if possible, by extirpation with ligation of the afferent and efferent vessels of the tumour. During the operation hæmorrhage may be prevented by a tourniquet around the head just above the ears. It may be necessary to remove a portion of the scalp corresponding to the tumour.

The treatment of **cirsoid aneurysms** is purely surgical, and should be undertaken as early as possible. The less extensive the tumour, the greater are the chances of success. The operation of choice is extirpation, hæmorrhage being controlled by a tourniquet around the head; or one can obviate hæmorrhage by a preliminary ligature of the larger afferent vessels, temporal, supra-orbital, post-auricular or even the external carotid. The operation should be done at one sitting, although, should the state of the patient require it, it may be done in two stages, as advised by Krause. The older methods of treatment by compression, ligature at a distance, and coagulating injections are not without danger, and are of doubtful value.

Vascular tumours in communication with the intra-cranial venous circulation.—These tumours are formed of venous blood-vessels in communication through a perforation in the skull with the intra-cranial circulation.

The treatment should be by extirpation of the tumour where indicated. Operation, however, is only indicated where the tumour is increasing in size, where it is causing functional symptoms and especially if the overlying integuments have become thinned and are threatening to ulcerate. In the traumatic cases direct compression with a view to immobilising the bony fragments of the fracture, and favouring cicatrisation of the open vessels, while stopping the circulation of blood in the hæmatoma should be used. The sooner after the accident that treatment is commenced the greater are the chances of success. Should this fail, direct surgical intervention may be carried out. It should be remembered that there is no proper sac to the tumour that can be exposed by dissection and ligated off. To obliterate the communication between the sinus and the tumour it is necessary to expose the sinus sufficiently to perform lateral suture or total ligation of the sinus.

In the case of the tumours of congenital origin, either hernia of the sinus or pericranial angioma, the outer covering of the tumour should be exposed and dissected down to its pedicle, which should be tied by one or more ligatures at its outlet through the bone. The tumour itself can then be completely removed.

TUMOURS GROWING FROM THE BONY WALLS OF THE CRANIUM.

These may arise either from the base, in which case they are inaccessible to surgical treatment, or from the vault.

The rarer tumours are hydatid cyst, chondroma and carcinoma: the more common, exostosis and sarcoma.

Hydatid Cysts of the skull are very rare, and as a rule arise in communication with the outer surface of the dura mater and invade the bone secondarily. The treatment consists in trephining the skull over the cyst, opening the latter, extirpating the cyst wall and packing the cavity with gauze.

Carcinoma of the bones of the skull is always metastatic, secondary to carcinoma in some other part of the body, and especially to carcinoma of the breast or of the prostate. Any form of treatment is quite unavailing from the curative point of view.

Sarcomata may arise either from the base or the vault, the temporal region being the region most often affected. The only treatment which is of any avail is extirpation of the tumour. This, however, is not always possible. Intervention is counter-indicated in the presence of metastases in the viscera, when the general condition of the patient forbids operation, or when the tumour is too extensive for complete removal. Operation should not be undertaken when there exist cerebral symptoms which lead us to suspect a wide-spread invasion of the brain. If operation is decided upon the tumour should be freely exposed. If the overlying integuments are adherent they should be removed with the tumour.

Trephine openings are then placed around the tumour, care being taken to open only through normal tissue. These openings are then united with each other by the saw or chisel, and the included bone with tumour carefully removed. If the dura mater has been invaded the infected portion should be removed, and, if not, care should be taken to see that it is not injured. Means must be taken to secure adequate hæmostasis during the operation as the hæmorrhage is always very profuse. Where the dura is affected, the operation may be done in two stages. The bony tumour is removed at the first stage, the affected dura is then painted with pure carbolic acid to prevent infection of the overlying scalp. At a second stage, a week later, the affected dura mater is resected, together with any growth with may lie on the surface of the cortex. The earlier the operation and the freer the removal the better are the results.

Myeloma and Chloroma do not admit of surgical intervention, being local manifestations of a general condition.

Bony Tumours of the skull are described under the names of osteoma, exostosis and hyperostosis. They are essentially benign in character. Where small in size, and giving rise to no symptoms, they can be left alone. When, however, from their size they cause disfigurement, or from their position they give rise to functional symptoms, they should be removed. This is easily accomplished when they are of small size and arise from a pedicle. The base of the tumour is exposed and cut through on a level with the surface of the skull by means of a chisel and mallet, after the periosteum has been detached. If the tumour is of large size and very hard, it may be necessary to remove it piecemeal. It is clear that if exostosis is developing intra-cranially, its site will have to be determined by the neurological symptoms aided by radiography.

AIR-CONTAINING TUMOURS OF THE SKULL (CRANIAL PNEUMATOCELES).

These are caused by a collection of air situated beneath the cranial periosteum, which is raised up but not torn. It is due to a passage of air through a fracture of the bone communicating with one of the air cavities of the skull.

Two varieties are described: Frontal pneumatocele and the mastoid or masto-occipital pneumatocele.

In origin they may be traumatic or secondary to an osteitis, either syphilitic, tuberculous, osteomyelitic or actinomycotic.

The object of treatment should be two-fold: The evacuation of the air, and the cicatrisation of the abnormal orifice by which it communicates with the air-containing cavity. Several means have been proposed to attain this end. The simplest means is by evacuation of the air, followed by compression, in order to favour adhesions between the pericranial tissues and bone and so prevent the re-introduction of air. Injections of iodine into the space have been used in order to produce adhesions between the periosteum and the bone. Or the tumour may be opened, the interior curetted and the cavity packed with gauze, in order to obtain obliteration of the orifice of communication and the filling up of the space with granulation tissue. Finally an osteoplastic operation has been proposed in which the tumour is laid open to determine the site of the perforation, which is then closed by an osteoplastic operation. It is not likely that an osteoplastic operation will be found necessary, as simpler means are found to be adequate. Should the pneumatocele be infected it should be treated by free incision and drainage. In the traumatic cases attempts should be made to render the neighbouring air-cavities as aseptic as possible: in other words, the same precautions should be taken in this connection as for an ordinary fracture of the skull. In cases where the air lies beneath the inner table of the skull, causing pressure on the brain, it will be necessary to resort to trephining to relieve the condition. The treatment of the inflammatory pneumatocele is the same in every case: that is to say, the primary condition, be it syphilitic or tuberculous, must be attacked, the affected bone resected and any sequestra removed. The cavity should then be packed and drained in order to obtain healing by cicatrisation.

DONALD ARMOUR.

INFECTIVE LESIONS OF THE BRAIN AND ITS MEMBRANES.

INASMUCH as inflammation of the brain and its membranes is due in the majority of cases to some definite local cause, such as otitis media or an injury to the skull, it follows that in the first instance any such cause should be treated by appropriate surgical measures.

General treatment must be employed after dealing with the local focus. When no local cause is to be found, or when the local cause cannot be directly dealt with, as in meningitis secondary to a fracture of the anterior fossa involving the nasal cavities, general measures alone are available. The patient is confined to bed in a darkened room, and absolute quiet must be insisted upon. Icebags are applied to the head, and the bowels are freely opened by mercurial purges; the diet consists of fluids only. Diuresis by the exhibition of theocin-sodium acetate in 10 gr. doses is of value in lowering the blood-pressure: in robust patients venesection may be employed. For the relief of pain the application of leeches to the mastoid processes is often valuable; bromides may be given by the mouth or by the rectum for the same purpose. When the pain is intense, morphia should not be withheld.

Surgical measures apart from the direct treatment of a local focus are rarely applicable, owing to the intricate nature of the spaces and cavities to be drained, but temporary relief may at times be obtained by lumbar puncture.

For further details as to the treatment of these lesions and of cerebral abscess, *see* Injuries of the Head (Vol. I.) and Complications of Otitis Media (Vol. III.).

C. H. S. FRANKAU.

INJURIES AND DISEASES OF THE SPINE.

INJURIES OF THE SPINE.

Contusions of the back are common injuries seldom calling for serious treatment. Resulting from kicks, blows, falls and other incidents of civil life, they produce the usual results of pain, tenderness and stiffness, but swelling and discoloration are often long delayed or very inconspicuous, as the dense tissues of the back do not readily permit of much extravasation or œdema. In such simple cases it is seldom necessary to do more than provide for ordinary rubbing or more skilled massage, and it is usually advisable to avoid making the patient in any sense an invalid or confining him to bed. The dangers most to be guarded against are subsequent stiffness or neurotic troubles, and these are best obviated by encouraging the early use of the back. Such complications as the development of spinal caries or of rheumatoid changes are far less common, and the dread of them should not as a rule lead to too great anxiety, which is far more likely to produce the other troubles to which we have referred. If, however, there be any reason to suspect tuberculous disease a guarded prognosis must be given and a period of prolonged rest may be required. It is especially in children that spinal caries is to be feared, and fortunately children are far less liable than adults to neurotic troubles and far less likely to lie still in bed and encourage subsequent stiffness of the back. Where a child has received a contusion of the spine and continues to complain of pain or of difficulty in movement it is therefore well to keep it in bed until pain has entirely subsided, and to prevent as far as possible all use of the injured back by maintaining a fully recumbent position.

On the other hand, gouty and rheumatic subjects should in all cases receive some constitutional treatment, but any fixation or disuse of the spine should be carefully avoided and the back should be exercised as early and as much as possible, even at the expense of some pain; in such cases vigorous massage and the use of hot packs, radiant heat or hot douches, will be of great value.

Associated with severe contusions of the spine there is often at the outset a considerable amount of *shock* due probably not so much to the actual blow upon the spine as to the effects of a severe shake of the abdominal organs, with results similar to those of blows upon the abdomen. This condition will be associated with faintness, pallor and nausea or actual vomiting, but will as a rule rapidly pass away, leaving a certain amount of lassitude and fatigue, to which too much attention should not be drawn. So far as any definite treatment at all is required the case will be met by the use of a stimulant, and in such cases a single dose of alcohol will probably suffice.

In other cases the contusion may be associated with symptoms of concussion of the spine. We are not here concerned with the various neurotic phenomena to which the term "spinal concussion" was formerly applied, but with cases of true concussion in which after a severe blow, generally upon the lumbar region or in the neck, there may immediately ensue symptoms of paraplegia of a more or less well-defined type. In such cases there is usually a considerable amount of shock of the type already described, and to this is added extreme weakness and flaccidity of the limbs, diminution, or it may be absence of the deep reflexes, and difficulty in micturition and defæcation; sensation is also affected, but not to the extent of complete anæsthesia. The first essential of treatment in such cases is obviously complete rest, and the patient should be immediately placed in bed, the often defective circulation being restored by hot blankets and similar measures, while care is taken to avoid burning the partially anæsthetised limbs. As a rule, the paraplegic phenomena will begin to pass away within a few hours, and the whole of the alarming symptoms will subside in a day or two; hence it is seldom necessary to do more than give a short period of rest, nor is it often that the use of the catheter will be required. Unfortunately cases of this type cause great fear on the part of the patient and often great anxiety on that of his medical adviser, and hence there is grave danger of the development of neurotic troubles, not as a direct result of the injury, but from purely psychical causes. It is therefore of the utmost importance for the surgeon clearly to realise the essentially transient nature of true concussion of the spinal cord and to know that there is no evidence that it is ever followed by transverse myelitis or by any of the "system diseases" of the cord. It is essential that he should be able to encourage and reassure his patient, which he cannot do unless he has himself complete confidence in the issue. It is equally essential that he should satisfy himself that the case is one of mere concussion and not one of intraspinal hæmorrhage (*infra*), in which the ultimate results are very different.

The immediate paraplegic symptoms of concussion having passed away, there will probably remain for a few weeks some general weakness and sense of fatigue, and treatment should now be of a tonic type both mentally and physically, including, when practicable, a short stay in some genial climate, with moderate exercise daily, careful attention to the secretions, and as much amusement and distraction as may be obtainable. In the poorer classes convalescent hospitals are here of incalculable service, while among the well-to-do hotel life or a short sea voyage is to be recommended. But in all cases it must ever be borne in mind that an essential point is to prevent the development of neuroses.

In a class somewhat apart from contusions of other regions of the back stand **contusions of the coccyx.** Apart from fractures, the results of falls upon this bone are liable to produce severe and lasting **coccydynia or coccygodynia,** which, although more common in the female, is met with in both sexes. There is here a chronic inflammatory thickening of the fasciæ around the bone which becomes extremely tender; pain is not as a rule felt in the standing or recumbent position, but may make the ordinary sitting posture unbearable. The most obvious and immediate remedy is the provision of an air cushion to remove all pressure from the coccygeal region. Local applications, such as belladonna, will also tend to relieve pain, but it is not advisable to employ suppositories for this purpose. Where local rest by means of the air cushion fails to cure it will generally be wise to remove the whole or a detached portion of the bone, and thus to free the dense fibrous connections in which the pain is probably most often produced.

Sprains of the spine, although less common than contusions, are also frequently met with, and generally result from violent oscillations, such as those of railway collisions and of efforts in lifting or forcible bending of the back, as from the fall of a weight upon the shoulders. The pathology is largely inferential, but appears to consist in tearing or stretching of the muscular structures and fasciæ of the back, while in many cases there is probably some effusion into the intervertebral joints. Pain is in most cases the only definite symptom, and is as a rule immediate and severe, with tendency to long persistence. When the muscular or fibrous structures have principally suffered it tends to be localised on one or both sides of the line of spinous processes, while in other cases, in which probably the intervertebral joints are inflamed, it may be more sharply limited to a definite region of the spine, or may be associated with pain radiating along the distribution of the nerves which leave the spine at the level affected. In most cases the tendency to develop neurotic phenomena is even more marked than after contusions of the spine, and many cases are also complicated by the question of compensation, which greatly aggravates and prolongs the symptoms.

The treatment in the early stages will necessarily consist in rest in the recumbent position, while local applications of belladonna will relieve pain, but beyond this little can be done, and it is inadvisable to use narcotic drugs, except, perhaps, for the first night or two after the injury. At the earliest possible moment hot douching and massage of the back should be commenced, and every effort must be made to encourage the patient, to persuade him to go about his business, and to prevent the usually strong tendency to adopt invalid habits. Every practitioner of experience will have found that such sprains may occasionally lead to a long period of pain and discomfort, even when produced by accidents such as those of the hunting field, but that it is comparatively rare for disablement to persist for long unless the question of compensation arises, in which case the symptoms continue almost indefinitely and suffice to prevent the patient returning to active work. It is impossible to believe that the great majority of such prolonged cases are due to conscious malingering, and they can only be assigned to the disastrous influence of working up the "case" with a view to obtaining what is regarded as fair compensation. Hence there lies upon the practitioner a most serious responsibility in encouraging the injured man and in counteracting the baneful influences of his friends and legal advisers whose duty it is to state his case in the strongest terms. It cannot, therefore, be too clearly realised that the *moral* treatment of all such cases must ever be the most important. How far this is really assisted by any such methods as blistering, cauterisation and the like, is highly doubtful; but these may, if skilfully handled, be valuable adjuncts to the fundamental principle of encouragement and stimulation to the use of the stiff and painful back.

Wounds of the back present no special peculiarities unless they penetrate to the spinal canal, abdomen, or thorax. They usually heal well and are seldom serious in practice.

Wounds inflicted from behind may penetrate to the structures of the neck and may enter the thorax or abdomen, the kidney being especially liable to be thus injured, but the principles of treatment will best be considered in connection with other injuries of internal organs.

Wounds penetrating to the interior of the vertebral canal are rare except in military surgery, but stabs may be caused by a knife, by blows from a chisel and similar injuries, while the spine has also occasionally been penetrated by fine instruments (*e.g.*, an umbrella wire) passing through the pharynx. All deep wounds, especially punctured wounds, of the back must be carefully examined with a view to ascertaining whether the meninges or the spinal cord or its nerve roots have been involved.

The typical symptom of meningeal injury is the escape of cerebrospinal fluid, which may be profuse in quantity and which can be recognised by its low specific gravity and its action in reducing Fehling's solution. Injuries of the cord usually take the form of a more or less complete hemisection, with the production of Brown-Séquard's group of symptoms, while in the lumbar region injuries to the cauda equina produce homolateral paralysis and anæsthesia.

In all such cases it will probably be wise to open up the wound, follow its whole course, and make a most careful search for foreign bodies. Fragments of knife blades and the like are very liable to be broken off against the vertebral arches, fragments of clothing may be left in the bottom of the wound, and fractures of the arches, with the detachment of bony spiculæ, are also not rare. Hence it will often be necessary to perform a small laminectomy and to remove at least a portion of one or more arches. At the same time the cut theca will be closed and any divided nerve roots will also be sutured. Suture of the spinal cord itself is said to have proved successful in a few cases, but we cannot recommend any extension of the operation for this purpose. The removal of foreign bodies, the arrest of hæmorrhage, the relief of pressure by bony fragments or by effused blood, the coaptation of cut nerve fibres and of incised dura mater, the thorough sterilisation of the wound tract and the provision of drainage, are the essential surgical measures. The repair of a cut spinal cord appears to be physiologically impossible, and efforts to assist it by suture can therefore rarely be justifiable.

In the **gunshot wounds** of modern warfare, the "explosive action" of the bullet produces, as a rule, so much injury for a wide area around its course that, if the meninges or cord be involved at all, the latter will generally be damaged so hopelessly that surgical treatment is useless, and it is wise to be satisfied with draining the wound and making and keeping it aseptic. Wounds due to bullets of less velocity, such as those produced by revolver shots, will however be treated on the same lines as stabs (*see* Gunshot Wounds).

DISLOCATIONS AND FRACTURE-DISLOCATIONS.

Dislocations of the spine unaccompanied by fracture are exceedingly rare except in the cervical region, but there they may be either unilateral or bilateral. For all practical purposes it is however unnecessary to distinguish between bilateral dislocations which are and which are not accompanied by fracture, and we shall speak of these injuries collectively as "fracture-dislocations."

Unilateral luxations of the cervical vertebræ are occasionally met with, the head being generally displaced forwards and to one side, while an antero-posterior and lateral deflection of the spinous processes may be detected by the finger or the diagnosis is established by a skiagram. Injury to the spinal cord may or may not coexist. In such cases it is always desirable and often practicable to effect reduction. The patient being recumbent and the shoulders fixed by an assistant, the operator stands at the head of the patient, which he grasps firmly with both hands. Using the normal or apparently normal side as a fulcrum, the head is then firmly and strongly extended, carried over a little to that side, and then drawn back into a position of slight over-extension. There are numerous published accounts of successful reduction by this method, but most of them require the sanction of a skiagram to prove that dislocation has actually occurred and been reduced. In a good many cases the proceeding has been followed by cessation of respiration, which is however temporary, and it is by no means improbable that many of the recorded cases are due to displacement of the larynx rather than to dislocation of the spine.

In fracture-dislocations the upper of the two separated vertebræ is usually displaced forwards and downwards, the spine being at the time of the accident in a position of overflexion; spinous processes and laminæ are often broken away from the bodies by the same injury. The cord may altogether escape injury, especially in the lumbar region, or it and its nerve roots may be contused and torn in the most varying degree, the result varying from a slight hæmorrhage to complete severance of both cord and theca.

From the moment of the receipt of the injury the utmost care must be taken in handling the patient, and on no account must he be raised from the recumbent position in which he will probably be found. As quickly as possible and with a minimum of disturbance he should be placed flat upon the back on a water bed or the best available substitute, and in all manipulations which may subsequently be required he should be moved only by rolling him from side to side.

The displacement due to the injury will often be immediately overcome by the natural recoil of the overflexed spine, and re-extension will also be assisted and maintained by the dorsal decubitus, so that little or no angular curvature may be visible. If, however, marked kyphosis persists when the patient is laid down, it is wise at once to endeavour to re-extend the spine by forcible traction, which may be applied to the head and shoulders or to the shoulders and hips according to the region of injury. This having been done, an endeavour will then be made to form a precise diagnosis of the site and severity of the injury to the cord, arrangements will be made for the necessary nursing, and the question of whether or not to advise laminectomy will next arise. To this we shall refer immediately in connection with the whole question of laminectomy for spinal injury.

Fractures of the *spinous processes* alone and of the *laminæ*, apart from the bodies of the vertebræ, are much less common than the typical fracture-dislocations. They may be the result of direct violence, such as blows, falls, gunshot wounds, the bite of a horse, etc., or they may, like dislocations and fracture-dislocations, be due to overflexion of the spine, as in falls upon the head, buttocks, etc., in which case there has probably been some temporary luxation with recoil. Such injuries may or may not be associated with crushing of the cord, and detached fragments of spinous processes and laminæ may be impacted and give rise to pressure upon the cord or to fixation of the back. Apart from obvious mobility of the fragments, it is often possible to establish the diagnosis by radiography alone. In all these cases the displaced fragment or fragments must be restored to and fixed in their position, or if this cannot be done, they should be removed. Manipulation alone may suffice for the replacement of a detached spine or lamina, but more often it will be necessary to cut down to the seat of injury and replace with sutures of wire or other material, or, if fixation is impracticable, to remove the piece of bone. Or again, if the latter be impacted between two adjacent laminæ, a more or less definite laminectomy may be required.

Hæmorrhage into the spinal canal may and very frequently does result from any of the above injuries. In the theca it constitutes hæmatorrhachis, in the spinal cord it is known as hæmatomyelia, while hæmorrhage external to the theca is a common condition in all forms of wound, fracture or luxation, and hardly requires separate consideration. In the great majority of all forms operation will not be of service. Thus in hæmatomyelia nothing is to be gained by cutting down upon a spinal cord the substance of which has already been more or less ploughed up by a hæmorrhage, while in other varieties the pressure of hæmorrhage will generally be of minor importance as compared with that of displaced bone or with the damage resulting from contusion or rupture of the cord. In the rare cases in which paralysis extends steadily upwards, indicating a "gravitating" hæmorrhage into the theca, it would, however, undoubtedly be wise to relieve pressure by lumbar puncture or by a laminectomy in the lumbar region.

The *late results* of hæmorrhage may appear as a pachymeningitis, which causes a stationary or even a progressive paralysis of the usual type of pressure lesion. In such cases the removal by laminectomy of cicatricial tissue is often of the greatest value.

THE OPERATIVE TREATMENT OF SEVERE SPINAL INJURIES.

As the various forms of injury to which we have referred are by no means readily distinguishable clinically, the question will often arise as to whether or not it is advisable to operate in a case of injury to the back associated with paralytic symptoms which are not merely evanescent and which cannot be assigned to concussion alone. The question has been variously answered, and a few successes or *quasi*-successes have led some surgeons to speak with enthusiasm of operating in all cases, but unfortunately the great majority have not given satisfactory results, while it is always difficult to be sure how far "recoveries" are due to the operation and how far they are the natural result of an incomplete crush of the cord. After a considerable personal experience the writer is driven to the following conclusions:

In the great majority of cases of fracture-dislocation with injury to the spinal cord laminectomy is useless.

The prospects of relief are best in cases in which there is evidence that the cord is not totally destroyed, as when some motor power or sensation is retained and when the deep reflexes are not abolished below the level of the lesion.

In a very few cases operation may reveal a hæmorrhage, an impacted spicule of bone or other readily removable source of pressure or irritation.

Operation must therefore never be held out as offering any but a small hope of success, but, the situation having been fully explained to the patient or his friends, it may, if desired, be undertaken as giving the best chance of relief. If undertaken it should be complete in the sense of including a search for and removal of all possible sources of pressure, including the pressure backwards of the body of the lower of the affected vertebræ.

These remarks apply only to fracture-dislocations with crushing of the cord; the conditions are different in fractures of the spinous processes and of the laminæ, in which we have already seen that operation will frequently be advisable. They are also different in cases in which the injury lies so low down as to spare the spinal cord.

The cord terminates at the lower border of the first lumbar vertebra, and beneath this point the theca and the vertebral canal are occupied by the nerves of the *cauda equina*. These roots are essentially peripheral nerves and they possess powers of repair similar to those of other peripheral nerves. When crushed, compressed or even divided, they are not, like the cord itself, physiologically incapable of regeneration. Hence in injuries below the first lumbar vertebra laminectomy with relief of compression, whatever its cause, or with suture of divided roots, has given some excellent results and should always be practised in cases in which symptoms persist after a reasonable time, say a month or six weeks.

In some cases of injury *paraplegia* comes on *at a late date* as the result of meningitis, the formation of callus and similar conditions. In these we have pressure lesions more analogous to those produced by tumours than to crushing, and there is therefore much to hope from operation, and in such cases laminectomy will generally be advisable.

As regards the date of operation it would seem clear that in cases of crushing of the cord, if it is to be undertaken at all, it should be at the earliest possible moment, with the sole exception that immediate shock may be allowed to pass away. In most cases the practitioner need hardly trouble about this consideration, as the necessary preparations and probable consultations will usually occupy as much time as can be spared.

In cases of increasing paralysis, such as arise from hæmorrhage, it is also important not to delay if operation is to be of any service.

In injuries of the cauda equina, on the other hand, it is quite possible that spontaneous recovery may ensue, and in fact such recovery may be anticipated unless nerve roots are actually severed. Hence it is probably advisable to wait for some few weeks unless the case is clearly getting worse or unless a radiogram shows marked displacement of the vertebræ or cystitis is directly threatening life.

The operation of laminectomy consists in removing the arches of one or more vertebræ with a view to relieving the spinal cord from the direct pressure of bone or of opening the spinal canal to permit of removal of any source of pressure therein. In fracture-dislocations the arch of the upper displaced vertebra is almost invariably carried forward, and compression occurs between this arch and the posterior aspect of the body of the vertebra next below; hence the arch to be removed is not the one which is prominent in the back, but that which lies next above it, and it may also be necessary to remove a portion of the body of the lower or fixed vertebra. The incision is generally made in the middle line of the back and muscles are retracted to each side, bleeding being arrested by pressure. The displaced laminæ are then cut away, any foreign bodies or fragments of bone removed and blood clot carefully sponged away. The dura mater thus exposed is freely laid bare throughout the region of injury; if it be pressed upon from the front the bony projection there is also cut away. Should the dura mater be torn it will have to be sutured, and suture of the spinal cord itself is also occasionally adopted, although there are very few cases in which anything can be hoped for from such a proceeding; nerve roots and especially the fibres of the cauda equina should, however, certainly be sutured if divided. The parts exposed are once more thoroughly cleared of any blood clot or *débris*; the muscles are brought together in layers over the exposed theca and the wound finally closed, drainage not being necessary unless there be a doubt about sepsis. The operation is by no means a very severe one; the wounds heal readily, and the death rate is about 5 per cent.

THE NON-OPERATIVE TREATMENT OF SEVERE SPINAL INJURIES.

Apart from laminectomy the treatment of injuries of the spine consists in providing such a period of complete rest as will allow of repair of the actual bone lesion and in treating certain complications.

Confinement to bed is obviously not only essential but inevitable, and in the majority of cases will unfortunately continue for the rest of life. In favourable cases the patient may however recover so far as to be able to sit up or even to leave his bed, and in such it is essential to keep him recumbent until bony repair is effected. For this purpose a period of six or eight weeks will be required. At the end of that time the back itself will probably be quite strong, and it is better for the patient now to depend upon his own spine than upon any support or jacket, the use of which will maintain the weakness of his muscles without giving actual rigid support to his bones. As a general rule, we should advise, say two months, lying flat in bed and then allow the patient to be propped up and shortly afterwards to try to sit in a chair or walk about.

During the whole of the period of confinement to bed it will be necessary to guard most carefully against the appearance of bedsores (*infra*), and the general health must be carefully maintained. The diet must be light. The bowels, which are usually much constipated, must be carefully controlled, but too great relaxation must be guarded against, as any tendency to diarrhœa increases the danger of bedsores.

Drugs are of little avail except to meet symptoms, morphia being used for pain or chloral and bromide of potassium for sleeplessness. Ergot is often given in the earliest stage with the view of lessening hæmorrhage into the cord, but there is no evidence that it has any real value. Belladonna appears to lessen muscular spasm and also aids in relieving pain; strychnine is dangerous and may increase the tendency to muscular spasm.

The position of the limbs must be carefully watched, as faulty attitudes are easily acquired and may become permanent. Talipes equinus is especially apt to ensue from the weight of the foot causing the toes to point, especially if pressed upon by the bedclothes. Such conditions can be remedied by the use of suitable cushions and the relief of weight by a cage over the legs. The whole body should be kept warm and dry, and it is well to use garments which can be readily removed; pyjamas of which the jacket opens at the back and with trousers only opening down the sides of the legs are readily handled. Hot bottles are best avoided altogether, but all clothes should be most carefully aired, and warm flannels may be used or the limbs may be encased in Gamgee tissue and light bandages. In private houses it is important to see that the bed is narrow and of a suitable height for convenience in nursing.

After the first week massage or stimulation of the circulation in the limbs by mild electric or faradic currents is useful and tends to prevent muscular wasting. After the patient begins to get up he will probably require a wheeled chair which he can use with his own hands, and at a further stage he may be able to go about on crutches. But as soon as any power is acquired in the limbs and the back is strong enough every effort should be made to cultivate muscular power by gymnastic exercises, the limbs being moved in various directions against the resistance of rubber bands, as with a Wheatley's exerciser or against the masseur.

In addition to the above points the medical adviser may be called upon to deal with certain *complications*.

Hyperpyrexia is almost always, if not always, fatal, and when the temperature begins to rise quickly (usually about the third day and in cervical injuries) we may conclude that there is nothing further to be done and that even had there been any hope from laminectomy the time for operation has gone by.

Bronchitis and Pneumonia are of similar import and are in fact often coexistent with hyperpyrexia.

Retention of Urine is usually present in serious injuries and will early require the use of the catheter. Having regard to the fact that the risk of infection of the bladder is very great, it has been advised that no catheter should be used, but such a line of action tends greatly to increase the risk of bedsores and seriously injures the bladder itself in a case which may otherwise turn out fairly satisfactory, while, as a matter of actual observation, cystitis does ensue even when no catheter is used, organisms probably entering the bladder by the dilated urethra with its continual stream of overflowing urine. Hence, in all cases of retention, the catheter should be regularly employed.

The most careful precautions are required in the use of this instrument. Previous to its introduction the prepuce, glans and meatus should be carefully washed with 1 in 2,000 solution of corrosive sublimate, and it is also wise at all times to keep the end of the penis wrapped in lint wet with a 1 in 5,000 solution. The catheter may be of silver or rubber, the former being most easily rendered quite aseptic while the latter is less likely to inflict injury on the urethra; on the whole, I prefer silver, and in experienced hands there should be no risk of injury. After use the instrument should be washed and syringed out with cold water and then boiled; it is then kept in a solution of carbolic acid (1 in 20) and again boiled before using. An excellent method of cleaning the bore of the catheter is to blow down it steam from a Ward-Cousins' boiler, or the instrument may be kept in formalin vapour in one or other of the boxes or jars sold for that purpose. The lubricant should be sterile, and for this purpose we prefer liquid paraffin, which can be kept in a deep bottle and sterilised by heating in a water bath before use, or we may use collapsible tubes of any sterilised lubricant. Lastly, care should be taken not to allow air to enter the bladder as the instrument is withdrawn.

In some cases retention of urine is replaced by a **reflex incontinence**, the bladder emptying its contents at frequent intervals. Here the catheter is not required, but the glans penis should be protected as in retention and the patient should have a glass urine bottle frequently sterilised by boiling.

When **cystitis** has occurred the prognosis becomes extremely serious, especially if, as is not altogether rare, the patient has gonorrhœa at the time of the accident. It is now necessary to wash out the bladder frequently, say three times daily, with some antiseptic solution, using the same precautions as in catheterisation. Such washing should be conducted by means of a funnel and tube and not by a syringe, which is difficult both to clean and to control. The most various antiseptics have been used for this purpose, but probably an isotonic solution of boracic acid (1 in 20), or even isotonic saline solution alone, is as useful as anything, and the bladder should be left empty by running out the last drops through a funnel. When the urine is highly alkaline and full of sticky mucus we may add 5 grs. of sulphate of quinine and ten drops of dilute sulphuric acid to each ounce of the lotion. By the mouth it is advisable to give salol or urotropine in 5 gr. doses, and the acid phosphate of sodium may also be given to reduce alkalinity, while for hæmorrhage hamamelis or terebene is useful. Severe hæmorrhage may be checked by introducing adrenalin, but calcium chloride must not be given, as it increases the tendency to form firm clots which are difficult to get rid of.

Where the vesical centre is injured and cystitis severe but the suprapubic region is not anæsthetic and therefore not peculiarly prone to sloughing, it is wise to insert a drainage tube above the pubes. This should not reach to the base of the bladder so as to impinge upon it, and the wound requires most careful dressing by painting the skin with sterile liquid paraffin and absorbing all urine with moss-paper (*moos-papier*), or by Hamilton Irving's tube. By such means the bladder may be kept almost empty and may be very thoroughly washed out at frequent intervals.

Equally important with the management of the bladder is the prevention of bedsores, which are most liable to form not only on the back but on any points of pressure, such as the heels and the great trochanters, on which the patient may rest, the dorsum of the toes, which may be pressed upon by bedclothes, and the knees, which may either receive the weight of the bedclothes or be pressed together, especially in cases of spasmodic contraction. The patient should be placed upon a water bed from the first, and the most scrupulous care is necessary to avoid soiling by fæces or urine, the escape of crumbs of food, or the formation of folds in draw-sheets and bedclothes. A cage should protect the feet not only to prevent bedsores, but also to prevent the weight of the clothes increasing the formation of a talipes equinus. Pads of the shape of a large corn plaster or small life-buoy must be used to protect all points of pressure, and any marked kyphosis due to the injury must especially be watched. If there is much perspiration all clothes must be frequently changed.

All points of pressure should also be carefully inspected twice daily and thoroughly washed, gently dried with cotton-wool, then rubbed lightly with alcohol and finally dusted with powdered boracic acid. Should redness supervene it is well to use some balsamic preparation, and the part may be painted with *collodion flexile* or protected by a thin sheet of gauze, painted with compound tincture of benzoin or dressed with lint spread with balsam of Peru. Lastly, should sloughs form they must be dressed with some antiseptic ointment, such as the official unguentum boracis, and after their separation healing is promoted by zinc ointment. Even in severe cases these measures should be persisted in, and it is remarkable what severe bedsores may eventually heal with careful nursing.

WILLIAM THORBURN.

DISEASES OF THE SPINE.

SPINA BIFIDA.

Spontaneous cure in spina bifida does take place occasionally. In all cases in which this is suspected from a gradual shrinkage of the sac, the patient should be treated on conservative lines by appliances affording protection from violence. Spontaneous cure may also take place from rupture and ulceration, but these processes are also the most common causes of death, and the risk of septic meningitis is too great to justify waiting for Nature to accomplish healing. Protection against rupture and abrasions should be maintained in all classes till the time for surgical intervention arrives.

Simple tapping should never be resorted to as a curative procedure. The method does not rest upon any scientific basis, and is too fatal to warrant its use. It is followed by a rapid re-accumulation of the fluid, and in some cases sudden death has followed its use. In any case, repeated tappings are apt to result in leakage, which sooner or later leads to death from meningitis or exhaustion. Aspiration is therefore only of value as a palliative measure when the tumour is tense and ulcerated. By withdrawing the fluid, rupture may be avoided, and time given for the ulcer to heal before proceeding to excision. Leakage may generally be prevented by using a hollow needle, as fine as possible. It should be passed obliquely through the muscles at the base of the sac. A collodion dressing should be applied, and the child kept in a recumbent position. **Strangulation of the sac**, introduced by Bell in 1791, needs only to be mentioned to be condemned. According to this method, an elastic band is placed around the base of the sac, and prevented from slipping by a clamp, or by two needles passed through the sac at right angles to each other. **Pressure** to prevent any increase in size of the swelling must be used with the greatest caution. It is only applicable to those cases in which the tumour is of very small size, and covered with normal, well-nourished skin. The great liability to ulceration of the coverings of the sac renders this form of treatment of very limited application.

Palliative treatment is indicated in all cases unsuitable for operation, either from the variety of the tumour or the condition of the sac. It may also be used as a temporary measure in cases unsuitable for immediate operation, on account of the age or general condition of the patient, or where the coverings of the sac are septic and time is desired to get them clean.

It consists of protection of the tumour from injury, and the prevention or lessening of septic infection. This is obtained by some form of shield made of perforated celluloid or aluminium, accurately fitted over the tumour, and fixed by strapping round its margin to prevent it shifting its position. A broad abdominal belt should also be applied. Great care must be taken to prevent soiling of the tumour by fæces, especially when situated low down. If ulceration is present, treatment by antiseptic dressings should be persevered with to promote healing.

Treatment by injection into the sac of an iodo-glycerin solution, usually known as Morton's fluid, from the name of its introducer, is the only other treatment besides excision which will be referred to.

The operation by injection of Morton's fluid is as follows: A syringe which will hold about ʒij of the iodo-glycerin solution is chosen. The calibre of the needle must be such that the thick fluid will pass through it readily. The fluid for injection consists of iodine (gr. 10), iodide of potassium (gr. 30), glycerin (ʒj). The sac having been cleaned, the puncture should be made well to one side, obliquely through the healthy skin, and not through the membranous sac wall, the objects being to avoid wounding the cord or nerves and to diminish the risk of subsequent leakage of cerebrospinal fluid. The question as to whether the sac should be emptied to any extent depends upon its size. Unless it is very large, it is probably better not to draw off much (if any) of the fluid on the first occasion. The child should be laid upon its side, and about 1 drachm of the iodo-glycerin solution should be injected. Every care must be taken to prevent any escape of cerebro-spinal fluid both at the time of operation and afterwards. If once established, this leakage is difficult to stop, and will probably lead to septic meningitis and death.

On careful withdrawal of the needle, the puncture wound should be immediately closed with a collodion dressing, a dressing of dry gauze being also secured with collodion over it.

An anæsthetic may be given to prevent any crying or straining at the time. The child should be kept as quiet as possible afterwards on its side, and a careful watch should be kept for the first hour or two to see that no leakage is going on. Shrinkage of the cyst setting in rapidly, and continuing steadily, shows that the operation has been successful.

If the injection fails altogether, or causes partial obliteration of the sac, it should be repeated at intervals of a week or ten days.

The great objection to the use of this method is the impossibility of telling what variety of spina bifida is present in any particular case; or, in other words, whether the sac does or does not contain the cord and nerve roots.

Simple meningoceles, which are best suited for the injection method, are also those in which the more radical treatment of excision is clearly indicated. So that treatment by excision may be said to be now almost universally adopted, except in those cases where excision is out of the question on account of ulceration and threatening rupture. Then the injection method may be tried, though time may be gained by aspiration through the healthy skin at the base of the sac in cases of threatened perforation.

The ideal operation of excision is one that will leave the cord unharmed, and secure a tight and subcutaneous union of the dura, through which cerebro-spinal fluid will not leak.

It is scarcely necessary to emphasise the primary importance of asepsis. If the skin is ulcerated, it should be sterilised by pure carbolic acid, followed by alcohol. The ulcerated area should be excised in fashioning the flaps. The patient should lie prone or upon one side with the hips elevated, and chloroform anæsthesia used. Every precaution should be taken to lessen shock during the operation.

The skin incision should be made in such a way as to furnish two flaps of sufficient size to close the wound without tension. It is an essential for success that the wound should heal by first intention. An elliptical incision in the long axis of the spine is the best, because it allows of the flaps being undercut in a lateral direction. It is important to have the sac full while separating the skin flaps. The sac, after free exposure down to the pedicle, should be opened into by a longitudinal incision along one side to avoid injuring the cord and nerve roots, which are more likely to run on the dorsal surface. The interior of the sac is then examined.

Meningoceles are the simplest to deal with. If no nerve roots are present, the sac is cut off, ligated or sewn up, according to the size of the neck. Should any nerve roots be exposed they are to be replaced in the vertebral groove. If adherent to the inner surface of the sac they must be carefully dissected off, or if this is not possible, the portion of sac wall to which they are adherent must be returned with them, or the sac may be involuted and made to serve as a tampon to close the opening.

It is well in closing the sac to arrange that the suture line in the meninges does not correspond with that of the skin. This may be done by suturing the meninges longitudinally and the skin transversely. A deep row of mattress sutures may be placed in the skin flaps in order to evert them, and thus obtain firmer union by bringing their deep surfaces into contact over a larger area. If there is tension the loops on either side may be threaded through a piece of rubber tubing.

Certain operators have endeavoured to cover the bony defect with more resistant tissue, in order to prevent the occurrence of a hernia. These methods materially complicate the operation and add to its danger, and therefore should not be employed; especially as the results of closing the deformity with meninges and skin are very good.

The only indications to be met in an operation for spina bifida are the removal of the sac and the closure of the cleft, and the simplest and quickest technique is the best. These patients cannot stand a prolonged operation.

No drainage should be used. The patient should be kept in a horizontal position, with the head lowered, if possible. It is not necessary to keep them off their backs. Asepsis must receive special attention in the after-treatment of the wound, and every care taken in nursing to prevent soiling of the wound by urine or fæces. The inner dressing may be covered with collodion, or by rubber tissue fastened around the edge by adhesive plaster. The outer dressings should be frequently changed.

Age for Operation.—The age at which operation takes place has a decided bearing upon mortality. Most surgeons advise waiting, if possible, for two or three months or longer, to allow for improvement in the general or local condition. Considering the large mortality during the first year, if we are to save life the operation must be done as early as possible. Otherwise surgery will lose the opportunity of curing or improving a number of cases. Late operation will have little or no effect in improving the paralysis. It will only remove the tumour.

Contra-indications to Operation.—The chief contra-indications to operation are marasmus and hydrocephalus. The excision of spina bifida will not cure the associated hydrocephalus. If congenital hydrocephalus is incurable, then the association of that condition with spina bifida constitutes a definite contra-indication to operation. Moreover, hydrocephalus frequently supervenes upon a successful operation for spina bifida.

Ulcerative processes in the region are temporary contra-indications for operation, for asepsis may be impossible. In a case of this sort one should first endeavour to heal the ulcers by the application of suitable dressings, and operate subsequently. Small ulcerations may not be a contra-indication when it is necessary for some reason or other to operate immediately, though the chances of infection are much greater than when the skin is intact. Where ulceration has led to rupture of the sac, it is practically impossible to obtain a successful result by operation.

The amount of paralysis present is one of the chief indications for or against operation. It may be said at once that complete paraplegia, with involvement of the sphincters, will not be cured by operation, and so constitutes a contra-indication. If the paralysis is due to tension of the nerve elements, and not to lack of development, one may expect improvement by operation. Therefore cases of partial paralysis may be operated upon. In many cases, however, all that can be expected from operation is the removal of an unsightly tumour, and the prevention of death by meningitis from rupture or ulceration of the sac.

ACUTE PERIOSTITIS AND OSTEOMYELITIS.

The general lines of treatment differ little from those to be followed in the same disease in other regions. They consist in the early evacuation of pus, and the removal of diseased bone if possible. Any treatment which does not include the evacuation and drainage of the abscess cavity, and removal of the diseased bone, is to be regarded as futile and temporising. While this is not difficult when the arches and spinous processes are affected, it is difficult to reach foci in the bodies of the vertebræ. The longer operation is delayed the greater becomes the danger of visceral complications and pyæmia.

Retro-pharyngeal abscesses should be attacked in the usual way through an incision along the posterior margin of the sterno-mastoid muscle. When the abscess is situated along the anterior region of the dorsal vertebræ, the transverse processes should be re-sected, with about 4 centimètres of the corresponding rib. In this way the pus may be reached and the sequestra removed. If the pleura has been perforated, the treatment is that of empyema. Psoas abscesses are best reached through an incision similar to that used for the same condition in Pott's disease, *i.e.*, by a vertical incision along the outer border of the erector spinæ muscle, and midway between the last rib and the crest of the ilium. The greatest care should be taken not to open the peritoneum. Suppuration in the true pelvis, along the anterior surface of the sacrum, is best reached through the perineum or through a peri-sacral incision. Special attention should be directed to ascertain whether the pus is in the vertebral canal or within the dura. If there is any suspicion that this may be the case, the canal should be freely opened by a laminectomy, and free drainage established.

When the bodies of the vertebræ are involved, one must try to prevent deformity in the same way as in tuberculosis, by keeping the patients on their backs, or by supporting the diseased portion of the spine. Extension may be applied, and later an appropriate jacket or corset may be necessary. Secondary operations for the removal of sequestra may be necessary.

In the minor cases, sufficient rest in the recumbent position, followed by support, will do all that is necessary.

SYPHILIS OF THE SPINE.

Congenital syphilis of the spine is the same condition as that found in other bones, and presents the typical picture of osteo-chondritis and periostitis.

Acquired syphilitic processes in this region almost always belong to the tertiary stage. In rare cases the primary sore, if on the posterior pharyngeal wall, may involve one of the vertebral bodies. More frequently it is a pharyngeal ulcer of tertiary origin, which, by its increase in depth, involves the upper vertebræ, and occasionally separates an entire vertebral body.

The treatment of syphilitic spondylitis should be both mechanical and medicinal. The mechanical portion, however, plays by far the least important part, and rest in bed, or on some form of portable bed, will be found to be more called for than braces. Rest in the recumbent posture during the painful stage is absolutely essential. In some cases it is positively indicated, in order to guard against the possibility of disastrous fracture of the vertebræ.

The medicinal treatment consists in the employment of "606" given intra-venously, as described elsewhere. Failing this, mercury and iodide should be employed, and large doses should be used. When the disease is once established it seems to follow the rule of all syphilitic lesions, and is a cumulative process rather than one of degeneration. When a certain point has been reached resolution takes place or the new tissue dies, and an abscess rapidly follows. If the abscess can be evacuated under favourable conditions the disease often goes on to rapid or complete recovery. Abscesses that are not within reach will almost invariably undergo rapid resolution when the patient is once well under the influence of treatment.

Sequestra should be removed by operation if possible, and the patient should be treated by extension, with rest in bed, in order to limit the permanent deformity. Any operation undertaken for the evacuation of an abscess or removal of a sequestrum must be performed on general surgical principles, the details being modified to suit the requirements of each particular case. Every precaution must be taken to prevent secondary infection by pyogenic organisms.

HYDATID DISEASE.

The bodies of the vertebræ are one of the portions of the skeleton most commonly affected in hydatid disease. Hydatid disease of the vertebræ may give rise to angular curvature and paraplegia, suggesting spinal caries, or if the cysts burrow through the intervertebral foramina, compressing the nerve trunks, malignant disease of the spine may be suggested.

Treatment consists in the majority of cases in the operation of laminectomy for the relief of the compression paraplegia, the cause of which is not usually recognised until operation. It may be that some cysts will be opened in cutting through the muscles of the back, and the disease recognised before the spinal canal is opened. Or it may be only on opening the canal that the cysts are met with. In either case the complete operation will be necessary to ensure the relief of the cord pressure. It is extremely rare to have to open the dura, the cysts in the vast majority of cases lying extra-durally. On exposure, the cysts should be scraped out and the wound irrigated with a strong solution of perchloride of mercury (1 in 500 to 1 in 1,000). Great care should be taken to see that the compression is entirely removed. A drain is left in and the wound closed in the usual way.

Should the disease be confined to the vertebræ and not causing symptoms of paraplegia, it is doubtful if it will be recognised before operation, unless there be visceral hydatid disease also, or unless a swelling has been opened in the muscles of the back which reveals the true nature of the affection. When situated in the vertebræ, the disease should be attacked and an effort made to get rid of it by scraping out the focus. The details of operation must be modified in each particular case, and depends upon the situation of the disease. Every care must be taken to avoid septic infection.

If bony destruction has taken place, care should be taken to prevent deformity occurring, or to prevent its increasing if already present. This may be done by recumbency with extension, as in tuberculous disease of the vertebræ. The possibility of spontaneous fracture occurring should always be borne in mind.

ACTINOMYCOSIS.

The spinal column is the favourite place of bone lesions due to actinomycosis. The disease is always secondary, the result of extension, and occurs in connection with disease elsewhere, compared with which the lesion in the spine is apt to be insignificant.

The treatment largely consists in internal medication by the administration of potassium iodide, rapidly increased up to 45 to 75 gr. three times daily. This remedy, however, should not be regarded as a specific, but as a preliminary measure to operative interference. The infiltrated area breaks down more rapidly after its use, and the fluctuating tumours become more accessible. When it is possible to clear out the cavity this should be done, and the wound packed with iodoform gauze, but with abscesses of the spine this is seldom possible. Good hygienic surroundings, with plenty of sunshine, fresh air, and good food, are also indicated.

NEW GROWTHS.

These may be classified, as elsewhere, as (1) benign, (2) malignant: primary and secondary.

The most favourable cases of tumour of the vertebral column for operative interference are those in which the neoplasm is benign in nature. In the case of carcinoma operative interference is useless. The chances are perhaps more favourable in sarcomata, because these sometimes develop in regions of the spine that are accessible, especially in the arches. Those rare cases of benign tumour, such as enchondroma, should be treated by operation when producing symptoms of cord or nerve pressure. If intra-spinal, their nature will probably only be determined at the time of operation, which will be laminectomy performed on the usual lines. If externally placed, the operation will be on ordinary surgical principles.

The majority of cases, however, are hopeless as far as a radical cure is concerned, and palliative measures can alone be adopted. The patient should be kept strictly in the horizontal position on a tolerably firm mattress and pillows arranged to obviate pressure. Extension is not well borne. A poroplastic jacket may, by steadying the spine, afford some relief to suffering, and render the necessary movements of the patient less painful. Anodynes must be used. Hypodermic injections of morphia, sparingly employed, will be required at a later stage of the disease. The danger of spontaneous fracture, attended with sudden displacement of the fragments and compression of the cord, should always be borne in mind, and necessitates the patient being kept strictly in the recumbent position.

As a palliative measure for the relief of pain, section of such posterior roots as are involved may be undertaken. Laminectomy is performed at the level of origin from the spinal cord of the nerves implicated. The dura is opened and the posterior nerve roots identified and cut through. The dura is then sutured and the wound closed in the ordinary way.

The treatment of inoperable sarcoma by bacterial toxins (the mixed toxins of the Streptococcus erysipelatosus and the Bacillus prodigiosus) has been introduced by Coley, of New York, who has reported numerous very successful results. The principle of this method of treatment depends upon the fact that in a number of cases of malignant disease, especially sarcoma, the tumour has disappeared under attacks of accidental erysipelas. Treatment should commence with an injection of ½ minim into the buttock, repeated after the temperature of reaction has fallen to normal. The dosage should only be increased when it fails to produce any reaction. The toxins should be given until the tumour has entirely disappeared, and then continued in smaller doses and at greater intervals for three or four months longer. If no improvement takes place at the end of four or five weeks, a successful result is not likely to occur, and retardation of the growth is all that can be expected from a further use of the toxins. There are certain risks connected with the treatment, and these should be fully explained to the patient before commencing treatment.

SACRO-ILIAC DISEASE.

Sacro-iliac disease is essentially a disease of young adult life, being slightly more common in men than in women. It occurs also in children. Chronic sacro-iliac disease is generally tuberculous.

The principles of treatment are the same as in all chronic joint affections. In the acute stage the patient should be kept upon his back in bed, with weight and pulley extension to the leg to steady the limb. As the acute symptoms subside, the patient may be allowed to go about on crutches, with a high sole upon the foot of the sound leg the weight of the other leg serving as extension. At the same time, in order to fix the joint as far as possible and to increase the comfort of the patient, a spica of plaster of Paris or a leather splint should be fixed about the pelvis. When an abscess has formed it should be opened, the diseased bone removed, and the wound treated as described under Pott's disease. Should the abscess be intra-pelvic, it may be necessary to remove a part of the iliac crest in order to reach it.

Excision of the sacro-iliac synchondrosis may be done in severe cases.

While under treatment these cases should receive tonic and constitutional treatment, as in Pott's disease.

COCCYGODYNIA.

Coccygodynia, as the name implies, is a painful affection of the coccyx. It may follow upon an injury, such as a fall or blow, but is more often seen in hysterical or neurasthenic females.

In treatment, care should always be taken to differentiate between the cases which are due to injury and those of a purely nervous origin. This is not always possible, because the symptoms may follow upon an injury to a neurotic subject. No operative treatment should be undertaken until all the resources of medical treatment are exhausted. This latter consists essentially in Weir-Mitchell treatment or the "rest cure." Operation should only be undertaken as a last resort, or as an adjunct to the Weir-Mitchell treatment. Certainly in the majority of cases operation alone will not cure the symptoms of neurasthenia.

The operation consists of excision of the coccyx, which is done by means of a longitudinal incision placed in the middle line of the posterior surface of the bone. The incision extends down to the bone, which is then cleared by means of a periosteal elevator or raspatory. The ligaments attaching it to the sacrum are then cut through and the bone removed. The wound is sewn up without drainage.

TUBERCULOUS DISEASE (SPINAL CARIES: POTT'S DISEASE).

The principles which govern the treatment of tuberculous disease of the spine are summed up as follows:

(1) The general constitution of the patient must be sustained by measures similar to those indicated in other manifestations of tuberculous disease.

(2) The disease is a local affection of the bones and joints of the spine, accompanied by symptoms of pain and deformity, which may be relieved or prevented by restraint of motion, protection from injury, and removal of superincumbent weight.

The treatment of the patient, as distinguished from the treatment of his deformity, is one of the more common and difficult problems, because patients are not often seen in the early stages of the disease. The object of the treatment should be the prevention of deformity, not only because the efficiency of the treatment is estimated by the result of such treatment on the deformity rather than by the survival of the patient, but because the deformity itself after recovery from the local and constitutional disease, by distortion and compression of vital organs, is a constant source of weakness or danger.

The early stage is the only period in the development of the disease in which recovery may take place in a manner which may be called ideal; that is, without deformity and with complete restoration of functional power in the spine.

The different regions of the spine, because of their position functions or relations, present certain peculiarities which influence treatment.

In the *cervical* region the indications for treatment are to prevent ultimate displacement of the head by placing it in the line of the normal spine and at a right angle to it. When the disease is accompanied by painful contraction of muscles and distortion of the head, the indications for treatment are the removal of superincumbent weight of the head and the relief of the muscles by active extension.

In disease of the *upper and middle dorsal* regions, the indications for treatment are to combat all deformities, primary or secondary, to prevent the forward inclination of the head and neck, to restrain unnecessary movements of the arms, to draw the shoulders back, and to prevent the secondary contraction of the chest.

In the *lower portions of the spine*, the indications for treatment are to restrain the awkward attitude of over-erectness and to guard against the effect of psoas contractions.

The deformities of Pott's disease may be divided into two groups: the essential and the non-essential.

The essential deformities are those produced by destruction of bone and loss of growth, two factors which are modified to a great extent by early diagnosis and efficient treatment. The non-essential and more distinctly preventable deformities are those which depend upon the symptoms and complications of the disease, one of which is muscular spasm. This is seen in disease of the cervical region, when the head may be drawn into a wry-neck position, which, if allowed to persist, becomes a permanent deformity; or the formation of an abscess which involves the muscles and fascia may induce a faulty attitude. In the lower region of the spine, when the erect posture is impossible, simple weakness is another element of deformity. After the cure of the primary disease the resulting deformity and general weakness favour secondary curvatures of the spine.

It may be said that in the treatment of Pott's disease, rest and fixation in a horizontal position fulfil all the mechanical conditions ; superincumbent weight is removed, functional disease of the spine ceases, jars and over-fatigue are impossible. On the other hand, this treatment is incomplete in itself; therefore it must be supplemented by some form of mechanical support when the erect position is again resumed.

The principle of treatment involved in any of the different methods is, however, exactly the same, namely, *diminution of pressure on the affected carious bodies*. In all cases an attempt should be made to prevent the superincumbent weight from pressing on the spine in such a way as to crowd the bodies together. The ideal treatment is that by which this essential condition can be attained without confining the patient to bed or the house.

The following methods of treatment may be considered: (1) Treatment by recumbency; (2) Ambulatory treatment: (*a*) Treatment by mechanical appliances; (*b*) treatment by means of plaster jackets.

(1) Treatment by Recumbency.—The advantages of treatment by recumbency are as follows: The patient is put at rest, is prevented from falling, and the superincumbent weight is removed from the spine. These advantages, however, are not obtained by simply placing the patient in bed and allowing him complete freedom of movement. He should be secured to a proper retention frame on which he can lie with comfort and be moved about, so as to have the benefit of change of air. To be effective the rest treatment must always include fixation and often extension.

The exact value of traction in addition to the recumbent treatment is difficult to determine. It is manifest that traction in certain regions may be injurious. Traction is indicated in cervical disease and may be applied with advantage to disease in the upper dorsal region with the aim of reducing deformity. Psoas contraction, even if complicated with abscess, often disappears under the influence of rest. If, however, this position has long been maintained, it may be necessary to apply traction to the legs.

The more immediate beneficial effects of recumbency are seen in improved appetite, the increase of flesh, and the diminution of fever.

The drawbacks to treatment by recumbency are that the patient is necessarily confined and the reparative processes may be thereby hindered. If treatment by recumbency is carried out for too great a length of time, the patient becomes pale, the appetite fails, the digestive functions are deranged, and the child loses ground. Under these circumstances, treatment by recumbency should be discontinued.

In short, it may be said that this stage of treatment should only last whilst evidence of an acute condition is present. It will, however, be found of great assistance during the acute or painful stage. In fact, thorough treatment is impossible at this stage without recumbency, for a while at least. Briefly, the indications for recumbency are pain and disinclination or disability on the part of the patient to walk or run about.

The treatment by recumbency is not often indicated in cases of great deformity, or in half-grown children or adults, except to meet certain indications, but it may be applied, and always with advantage, in the treatment of any region of the spine in infancy or early childhood.

(2) **Ambulatory Treatment.**—The basis of ambulatory treatment is fixation as complete as possible of the spine in as advantageous a position as is obtainable. In so chronic an affection as Pott's disease some form of appliance is necessary to establish a permanent cure. The drawback to portative appliances, however, is that it is impossible by their use to thoroughly remove the superincumbent weight.

The two types of appliances used are the plaster jacket and the spinal brace. Of the different forms of the latter appliance the antero-posterior support is the best.

The plaster jacket is in certain respects the most valuable means of treatment which has yet been devised; but it should be used only in suitable cases, and by persons who are trained in its application, for the application of a plaster jacket is not altogether an easy matter, and requires great attention to detail and a large amount of care.

Split plaster of Paris jackets, leather jackets, silicate jackets may be used in the later stages, as may also cloth corsets stiffened with steel strips.

Summary.—Pott's disease is one of the most curable surgical affections. Its treatment, however, involves care for a long period (three or four years), and all treatment short of that is treatment of only a stage. "The proper treatment of Pott's disease is not the application of any method, the use of any corset or brace, but the employment of such means as are most efficient for carrying out the object aimed at. A brace is useless in the case of persons unable to adjust it; a plaster jacket applied about the trunk is useless in disease of the cervical or high dorsal region. Recumbency carried to a point of depressing the patient's mental and physical condition is as much of a mistake as to drag a patient about who is anxious to lie down" (Bradford and Lovett).

During the acute painful stage absolute recumbency, with complete fixation, is the best treatment. In the stage of improvement the benefit of air and exercise is essential, and efficient support is necessary in this stage. An antero-posterior steel support is efficient and reliable if carefully fitted and well applied, but properly made is more expensive and demands much skill and time in its adjustment. In middle and lower dorsal disease the plaster jacket affords a ready and efficient means, applicable in cases where special skill is not obtainable, and where nursing is imperfect. The former is better in the more acute forms of the disease. Each case must be judged on its own merits as to whether recumbency for a time is required, or whether ambulatory treatment with fixation appliances is sufficient.

The question as to when treatment may be dispensed with in Pott's disease will be largely influenced by the type of patient. The amount of improvement in the general health of the patient attained at the beginning of the treatment is in a large measure a gauge of the efficiency of the treatment.

It is much safer to begin the disuse of appliances by degrees, substituting a lighter one at night, or for a short time during the day, while carefully watching for a return of pain or muscular weakness. Massage should be used to develop atrophied muscles.

After removal of all apparatus the patient should be watched for some time.

Paraplegia in Tuberculous Disease.—From the point of view of prophylaxis too much stress cannot be laid upon early diagnosis and prolonged rest in a recumbent position. If it were the rule to place and retain the patient in a recumbent position instead of allowing him to go about with a plaster jacket or other form of spinal support, paraplegia would rarely occur in Pott's disease. All such supports should be reserved for the stage when the disease is believed to be arrested. For cases in which paraplegia already exists, but is of recent origin, surgeons are agreed that the best treatment is elastic or weight extension in the recumbent posture. When an abscess exists and the paralysis has been developed suddenly, or when the sudden paraplegia is due to displacement backwards of an internal sequestrum, laminectomy is indicated. These conditions are, however, exceedingly rare. In cases in which the paraplegia has developed gradually, laminectomy should not be resorted to till fixation with or without extension has been given fair trial.

Apart from the condition of the patient and ordinary surgical considerations, there are three elements to be watched in determining the advisability of operative intervention: (1) The actual condition of the spinal cord; (2) The prospect of recovery of function without operation; (3) The prospect of recovery of function if the pressure is removed.

In the large majority of cases, especially in the earlier stages, the prospect of partial recovery is a very good one. Even in cases of total loss of motion and sensation recovery may occur. A fair conclusion would seem to be that so long as we have moderate chances of recovery without operation, it is not advisable to undertake laminectomy. On the other hand, when spontaneous recovery is hopeless, this procedure gives a prospect of success which should not be neglected.

The principal contra-indication, besides the obvious ones in the general conditions of the patient and his surroundings, is the presence of tuberculosis in some other part of the body. Unless there is some symptom threatening life, in such cases the operation should not be attempted.

Summary. The Contra-indications to Operation are:—(1) General health and general surgical considerations; (2) presence of tuberculosis in other parts of the body; (3) cases in which mechanical treatment has not been employed; (4) the presence of an abscess connected with caries, which can be otherwise evacuated; (5) acute exacerbation of symptoms, referable to the cord and not threatening life.

The Indications in Favour of an Operation are: (1) General good conditions and favourable surroundings :

(*a*) In cases where spinal disease is made out to be the cause of the paraplegia.

(*b*) Where the disease is slowly progressing to an unfavourable termination, during the application of intelligently applied apparatus, indicating a failure of mechanical treatment.

(*c*) Where the patient has more or less complete loss of motion and sensation below the level of the lesion, with incontinence of urine and fæces, and when the conditions have lasted for a sufficient length of time to render spontaneous recovery impossible, and not so long as to have produced loss of all recuperative power in the cord.

(*d*) In cases in which pressure myelitis threatens the integrity of the cord. The first sign of this demands immediate operation.

(2) Acute symptoms threatening life appear, when there is good prospect of their being cured by removal of compression.

Psoas Contraction.—Where flexion of one or both thighs has taken place in Pott's disease, it is not likely to diminish spontaneously, and so the contraction may become permanent. A permanent contraction of the psoas muscle with the thigh flexed is a serious deformity, whether it exists on one or both sides; therefore it is necessary to treat psoas contraction with very vigorous measures. In the early stages the patient should be put to bed, preferably on a frame, while light extension should be applied to the leg with a pulley, the patient being lowered till the leg is straight and the flexion overcome. In early cases this is usually accomplished in two or three weeks. If not, or if a more rapid method is desired, the patient should be anæsthetised and the leg straightened by force and put up in some retentive apparatus, such as plaster of Paris. Only moderate force should be used, and if it cannot be done with such, it is better to divide the fascia of the contracted joints. The operation should be done by the open method, rather than subcutaneously, for many of the bands are deep. In severe cases subtrochanteric osteotomy of the femur may be necessary; but it should not be done until after recovery from the disease in the spine.

Abscess in connection with Tuberculous Disease.—Abscess is a symptom of the disease, the importance of which is to be estimated by its effects. It may be prevented and its extent and course may be modified by proper treatment. The question to decide with regard to abscess connected with spinal caries is: What shall be done? Shall it be left alone, and, if so, how long? Shall it be opened, and, if so, when? The treatment must necessarily vary according to the seat of the disease, the location of the abscess, the accompanying symptoms, and the progress of the case. It is impossible to lay down one rule which is to be rigidly followed. The conditions of the patient, hygienic, physical, and social, will make a decided difference.

The surgical aspect of these abscesses varies greatly, and the location of the focus, the position of the disease, whether in the body of the vertebra, or anteriorly or laterally, or in the articular process, will greatly affect the possibility of reaching and removing it.

Lumbar caries gives a more direct route of entrance and a more hopeful prospect of the removal of all the tuberculous tissue. If the abscesses could be opened, thoroughly cleansed, all tuberculous material removed, any bone detritus washed away, with no infection of the external tissues and with perfect asepsis, the opening of every abscess would clearly be indicated. As long as the tuberculous abscess remains purely such, but little inconvenience may result to the patient and the symptoms are insignificant, but if a mixed or secondary infection occurs, all is changed. The condition of sepsis is added to one of tuberculosis. The secondary infection may not occur till some time after the abscess is opened, or it may occur at the time of opening. Efficient mechanical support to the spine will in a great many cases avoid the necessity for operative interference.

The ideal treatment of abscess arising from tuberculous disease of the spine is removal of the focus of disease to which the abscess is due, together with removal of the contents and walls of the abscess cavity. Unfortunately it is only in a small minority of cases that this is practicable. As a rule it is quite impossible to reach and clear away the carious focus in the spine. This method of dealing with the abscess cavity by careful cleansing and removing from it all carious and tuberculous material as far as possible, with an attempt at the obliteration of the cavity by immediate union of the walls, must be considered the most practical and scientific method of treatment in these cases. Failure is due either to the fact that the spinal disease is progressive or to imperfection of the operation. The whole of the morbid material may have been removed and yet more may descend the narrow tract leading to the wider abscess sac below. In such cases, if the abscess has been obliterated after the first operation, it will re-form sooner or later. The operation must then be repeated as in the first instance, and a third time or more if necessary. If after the first operation a sinus forms and persists, it should be carefully scraped out again as soon as it is clear that sound healing will not take place; otherwise tuberculous infiltration of the wall of the sinus is likely to take place.

In operating one general principle should underlie the operation upon all these abscesses. They should be dealt with as collections of tuberculous material and not as septic abscesses.

The following are the principles upon which the surgeon should proceed: The abscesses should be opened through the thickest layer of healthy tissue obtainable. They should not be opened in places where the skin is implicated or in the most prominent and inviting positions where they are near the surface. The reason for this is obvious: one wants to bring inwards the largest possible amount of uninfected tissue, in order to form a barrier between the uninfected interior and the surface of the body. For the same reason the opening should be made through, rather than between, muscles, for the subsequent closing of muscular structures divided in their long axes is more satisfactory than if the individual muscles are merely separated the one from the other. After the abscess has been opened by deliberately dividing, layer by layer, the overlying structures, and after the contents have been completely evacuated and the granulation tissue lining the walls scraped away, the cavity should be irrigated and then thoroughly dried. Closure should be effected with care. The structures that were divided last should be first accurately sutured, and the other coverings in the reverse order to that in which they were divided; and finally the skin wound should be closed and dressed with firm pressure to keep the walls in contact, and the cavity obliterated as far as possible. The solution used for irrigation is a matter of little importance, for none is left in the cavity, and its action is almost, if not wholly, a mechanical one.

It is a debatable point whether anything should be left in these cavities before they are closed. Various substances have been used with different objects in view. Iodoform emulsion in glycerine, small quantities of solution of zinc or carbolic acid have been used with the idea that they will destroy tubercle bacilli that may be exposed in the walls of the cavity. They may do so, but their action is very superficial, and their use is apt to be followed by a reaction and discharge of fluid into the cavity, which prevents the coalescence of the walls.

Should there be any difficulty in rendering the inetrior of the cavity quite dry a small quantity of solution of adrenalin will help considerably. The objection to the employment of drainage in these cavities is very great, and prolonged drainage should be avoided. It generally means septic infection at some time or other, guard against it as carefully as one may, and, even if it does not lead to septic infection, it means the establishment of a sinus which will continue to discharge tuberculous fluid for months. Many surgeons are in the habit of employing temporary drainage (twenty-four to thirty-six hours) to allow for the escape of the fluid which may collect in the cavity immediately after the operation. The objection to temporary drainage is that the presence of a drain even for so short a time means that the opening in the walls of the cavity cannot be completely closed, and the removal of the drain must mean a weak spot in the operative wound, which is very likely to become infected by tubercle, and so lead eventually to the formation of a sinus. It is better to syringe the cavity with adrenalin solution before closing the wound, to prevent the formation of fluid, or, if it does collect, to remove it by means of an aspirating needle, passed into the cavity from some spot on the surface other than that involved in the wound. The fluid is in this case thin and can easily be removed in this way. The aspiration may be repeated if necessary. Aspiration of the abscess as a primary measure is uncertain, for it rarely evacuates it completely. It is useful in the cases in which delay has occurred, and the relief of tension of the abscess is consequently necessary. The treatment by injection of the abscess cavity after operation is uncertain in its results, and when active germicides are used, there is danger of systemic poisoning.

It may be necessary to open the abscess in non-infected cases which are doing well, on account of interference in the application of mechanical support, or on account of interference of locomotion.

In abscesses of the *cervical* region the drainage as a rule presents but little difficulty, as they present themselves usually in the mouth or at the side of the neck. In some instances they appear under the sterno-mastoid muscle. The line of incision may be behind or in front of the muscle. The seat of incision will depend upon the size and situation of the abscess. The anterior incision is to be preferred if the abscess is pointing in front of the sterno-mastoid, though it is necessarily made nearer the large vessels. The incision is either that for ligature of the carotid, the vessels being pulled to the outside, when the abscess will be found between the vessels and the larynx and œsophagus; or when low down in the neck, the incision for ligature of the vertebral artery, which is made at the outer side of the sterno-mastoid. In other cases the incision should be made along the upper third of the posterior border of the sterno-mastoid muscle. The latter being drawn forward, the transverse processes of the vertebræ are defined and the abscess opened immediately in front of them.

When an abscess is situated in the *upper dorsal* region and in front of the spinal column, incision of the abscess is attended with difficulty, both as to localisation of the abscess and the line of incision.

Costo-transversectomy is an operation which has been recommended for cases of this kind. It consists of resection of the transverse processes of one of the vertebræ and a 'portion of the adjacent rib. A short incision is made slightly to the outside of the spinous processes, and is directed down upon the transverse processes at the junction of the ribs or a little to the outer side. The tissues are retracted, the periosteum separated from the head of the rib and the tip of the transverse process, and the end of the rib removed by means of bone forceps. Care should be taken to protect the pleura. A part of one or two of the ribs can be removed and the pleura can then be seen. By gentle manipulation the pleura can be separated from the infected vertebræ; the abscess will be found between the pleura and the bone.

The evacuation of a *psoas* abscess is best performed through an incision in the loin after the method known as Treves'. A vertical incision, with its centre midway between the crest of the ilium and the last rib, is made in the loin parallel to the vertebral side of the outer border of the erector spinæ muscle. The incision is about 2½ inches from the lumbar spinous processes. The aponeurosis covering the erector spinæ muscle is divided in the full length of the wound; the muscle is found and is drawn inwards to the middle line as far as possible. The fascia covering the quadratus lumborum is now incised, and the muscle exposed. The muscle should be divided close to the extremity of a transverse process, and the incision carefully enlarged till the muscle is divided in the full length of the wound. The psoas muscle is thus exposed, overlapping the inner edge of the quadratus lumborum. Some of the tendinous fibres of the psoas having been divided close to a transverse process, the finger is introduced beneath the muscle until the anterior aspect of the bodies of the vertebræ and the abscess cavity are reached.

DONALD ARMOUR.

DEFORMITIES.

I. FUNDAMENTAL PRINCIPLES OF TREATMENT.

Success in the treatment of deformities is only to be attained by untiring patience and the clear recognition of certain fundamental principles which form the basis of all methods adopted by different surgeons, however much they may appear to vary. The original cause of the deformity may be found in some congenital defect, in a paralysis, in rickets or simply in some postural fault; still there are certain features which, in varying degree, are common to all cases, and give the indication for certain principles of treatment applicable to all cases. When in doubt or difficulty the practitioner must fall back on these fundamental principles and, by their guidance, devise his treatment on commonsense lines.

All deformity is associated with adaptive changes in bone and soft structures. Though the changes usually start in soft structures, alterations soon occur in the structure of bone and thereafter the changes run concurrently.

As soon as a position of deformity is assumed the muscles and ligaments on the concave side shorten. They are then in a position of mechanical advantage as compared with their antagonists which have to work round the convex side. The muscles of the latter group are not only at a mechanical disadvantage but tend to atrophy from disuse, because they are overpowered by their short opponents, because in some cases they are compressed by the convexity of a bony deformity, and because they are stretched, and this means that the nerve terminals are also stretched. All this contributes to impair the efficiency of the muscle and make it no longer capable of maintaining the balance of power against its antagonists. Finally, if the action of gravity helps in increasing the deformity, its progressive development is assured. Hence we see that, quite apart from the original cause of the deformity, we have two factors always at work, viz., firstly, shortening of one group of muscles and ligaments and lengthening of their antagonists with a consequent disturbance of the balance of muscular power, and secondly, the action of gravity.

Now, even if the original cause has been transient, the deformity may remain, because one group of muscles is not strong enough to bring the limb back into its normal position. Unless this is speedily rectified changes in the structure of bone will follow in accordance with Wolff's law.

Wolff's Law.—Just as normal bones possess an internal framework constructed according to the mathematical laws of statics, so every change in the external form and function of a bone or of its function alone is followed by definite changes in its internal structure and equally definite changes in its outward form in accordance with mathematical rules.

Bearing this law in mind, it is obvious that deforming changes will be progressive so long as the muscular balance is unequal and so long as the body weight is improperly deflected. If, however, treatment is adopted: (1) To correct actual deformity; (2) to restore the balance of muscular power; (3) to deflect the body weight so that gravity will act beneficially instead of prejudicially, then, all growth during the period of recovery under treatment will tend to produce corrective changes in structure in accordance with Wolff's law, and this must be the aim of the surgeon.

The important part played by strong shortened muscles and by weak over-stretched muscles will be referred to again and again. For instance, in drop-wrist associated with lead palsy, or with drunkards' palsy or with polio-myelitis, the extensor group of muscles is over-stretched and the flexor is shortened, and recovery cannot be expected until the flexors have been stretched and the elongated extensors have been given an opportunity to shorten and recover their power of voluntary contraction. In quite a different way the same is true of congenital club-foot, for stretching or division of the shortened structures is not sufficient to produce a cure, relapse is almost certain if treatment is interrupted before the previously weak peronei and extensors are strong enough to keep the foot dorsi-flexed, abducted and everted. The same factor enters into the problem in the treatment of deformities after burns or after injuries to nerve trunks.

A want of recognition of these influences accounts for many of the failures in ultimate recovery after operations, such as tendon transplantation.

The test of recovery in the muscles is that they have attained the power of voluntarily over-correcting the previous deformities despite the action of gravity.

The chief cause of recurrence of deformity after treatment is that the recovery has been incomplete in some or all of the following respects: (1) Incomplete reduction of deformity; (2) incomplete recovery of muscular power; (3) incomplete protection of muscles and ligaments against undue strain, such as is produced by erroneous deflection of body weight.

Finally, before any operation on bone is undertaken for the correction of deformity, it is of the utmost importance that the maximum degree of correction should first be obtained by other means, such as manipulation and wrenching, splinting, and massage of muscles. The interference with bone is then reduced to a minimum, and the limb is less mutilated by the operative procedure.

II. DEFORMITIES OF THE UPPER LIMB.

Congenital Dislocation of the Shoulder Joint is very rare. There can be no doubt that many recorded cases were really cases of paralytic dislocation, in which the parents often give a vague history of the existence of the deformity from birth. Fracture of the neck of the humerus may occur at birth or in infancy without being discovered, and such cases when seen in later life have also been regarded as congenital dislocations. Such cases should be carefully excluded in making a diagnosis.

The condition may be bilateral and of any of the varieties described under traumatic dislocation. By far the most frequent type, however, is a posterior dislocation on to the dorsum scapulæ under the spine.

Treatment.—Reposition is the best treatment. Some estimate of the prospect of success may be formed by a careful examination of a good X-ray photograph. If this shows that the shapes of the head of the humerus and of the glenoid cavity are such as to render it possible to retain the parts in proper position, the procedure is as follows: Under an anæsthetic the arm is abducted and pulled to stretch all the structures about the shoulder. The surgeon then places one thumb in the axilla and with the other hand carries the elbow backwards and then inwards, using the thumb in the axilla as a fulcrum; he then stretches the short structures in front of the joint by working the head of the humerus outwards and forwards. When the head is brought into proper relation to the glenoid the arm is fixed as in Sayer's method of treating fracture of the clavicle, with the important difference that the elbow is carried *backwards* and *inwards* across the back, to keep the head of the humerus forward. The whole limb can then be fixed in position with plaster bandages for eight weeks or longer if necessary. After this movements may be begun.

In cases where reposition entirely fails operation may be considered. If one reflects for a moment on the very limited movement obtained by excision of the head of the humerus for *fracture-dislocation* and other conditions, and remembers that an open operation involves gouging out the glenoid and paring down or cutting away part of the head of the humerus, that is, interfering with two growing epiphyses, it will be obvious that an open operation in a child is not to be undertaken lightly.

On the other hand, very successful results may be obtained if reposition can be efficiently maintained.

Congenital Dislocation of the Elbow may be a displacement of both bones of the forearm either forward or backward on the humerus; in the former the development of the olecranon is very defective, and movement in any case is limited. The condition is extremely rare.

Treatment should be directed to securing a useful joint. We have always maintained that flexion is the most important movement of the elbow-joint, and in all conditions of disease or injury of the elbow we aim at securing a result which will allow the patient to bring the hand to the mouth and back of the head and be able to feed herself, do her own hair and so forth. If ankylosis is inevitable, let it be at less than a right angle. Treatment should therefore be in the flexed position.

Congenital Dislocation of the Head of the Radius is much more common and is frequently bilateral. The head of the radius, displaced either backwards or forwards, blocks the movement of the elbow. Pronation and supination may be present or may be obstructed by adventitious union with the ulna.

Treatment.—(1) When supination and pronation are possible and where the head of the radius can be brought into normal relation to the capitellum in full flexion, the elbow should be fully flexed and the forearm supinated, and the limb kept in this position for several weeks. This should be followed by massage and movement. (2) Operative treatment consists in excision of the head of the radius and free separation of any fixed attachments of the radius to the ulna. This should be followed by rest in the position described above and subsequently by massage and exercise.

Congenital Defects of the Ulna and Radius.—*Congenital Absence of the Ulna* is a very rare condition which may be associated with absence of some of the fingers on the ulnar side of the hand. In these cases little can be done to improve the usefulness of the hand. Even partial defects of the olecranon, coronoid or styloid processes are so rare that no definite rules can be laid down for their treatment.

Absence of the Radius, total or partial, is much more common and gives rise to one form of club-hand. The scaphoid, trapezium and thumb may be absent, but more frequently all the digits are present. Owing to the defect of the radius the ulna is bent and the hand is flexed to the radial side. The only practicable treatment is first to get the ulna straight. In a young child this may be done by manual force; the ulna is then put on a straight splint, and the case is treated as one of greenstick fracture. In older children osteotomy of the ulna may be necessary. The hand must next be brought into line with the ulna, and a splint must always be worn to replace the absent radius and prevent the ulna from again becoming curved. In some cases an arthrodesis or ankylosis of the wrist must be produced. Bardenheuer has done this by splitting the lower end of the ulna (which in these cases is always thicker than normal) and fixing some of the proximal row of the carpus into the cleft. Extensive operations on tendons and soft parts are to be avoided, as they do not lead to any satisfactory result.

Congenital Dislocation of the Wrist is very rare. The hand as a rule is well formed, but the ligaments are very slack. Reposition is easy.

Treatment should consist in reposition and prolonged fixation in plaster, or in a suitable splint which the patient cannot remove, till the ligaments have had time to shorten. Massage and gentle exercise will then further strengthen the weak structures, which should, however, be supported by wearing a firm leather mitten.

Congenital Contraction of the Wrist must be clearly distinguished from the form of club-hand which is due to absence or defect of bone (*vide* Absence of Radius). There is no defect of any structure, but, owing to long retention in one position *in utero*, the structures on one side of the hand are contracted as in club-foot. The varieties are described as radial, ulnar, palmar or dorsal, according to the direction of the contraction, or some combination of these may occur, of which the most common is ulno-palmar club-hand.

Treatment must be patient and systematic, and may have to be continued for years. All contracted structures must first be stretched and the hand put up in the over-corrected position, in which it must be kept till the weak muscles and ligaments, which were previously stretched, shorten and recover their power. The test of recovery is that the patient can voluntarily bring the hand into the over-corrected position. If the treatment is stopped before this stage is reached relapse is almost inevitable and freedom of movement will certainly be impaired.

Congenital Dislocation of the Fingers is a rare condition which has been known to occur in several members of a family or in conjunction with other deformities. The treatment is reposition and retention on the principles already laid down.

Congenital Contraction of the Fingers is usually a hereditary contracture of the palmar aspect of the first interphalangeal joint of the little finger, "Hammer-finger." The condition will usually yield to the continuous application of a splint, but a small plastic operation may be necessary in very stubborn cases.

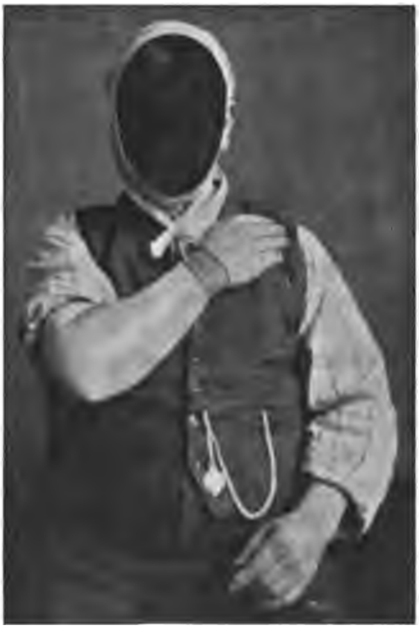

FIG. 1.—The "halter" or "collar and cuff."

Congenital Lateral Deviation of the Phalanges, usually of the terminal phalanx of the thumb, either to the ulnar or radial side, has been described by several writers. The condition has a tendency to occur in several members of a family or in collaterals.

The mobility of this joint is not impaired. Treatment is correction with a splint to maintain the position of the phalanx. A cuneiform section of the shaft of the phalanx is preferable to excision of the articular end in cases when operation is necessary.

Cubitus Valgus and Varus are deformities at the elbow-joint, corresponding to knock-knee and bow-leg at the knee-joint. The former consists of an exaggeration of the carrying angle, the latter of a diminution or reversal of the angle.

(1) The condition may be rachitic in origin, and is then associated with considerable slackness of the ligaments. The treatment of this form is complete rest of the elbow-joint. The best way of obtaining this is to fix the wrist close under the chin in a "halter" (Fig. 1), and wait till the slack ligaments shorten and the joint becomes stable.

(2) Traumatic cubitus, valgus and varus, is much more common as a sequel to fractures through the condyles. The use of the traditional internal right-angled splint is undoubtedly responsible for

many of these cases. All such injuries should be treated in the fully flexed position, for the tendon of the triceps is the best splint for the elbow-joint. Once the condition has occurred it is necessary in many cases to perform osteotomy above the condyles, cut away any projecting spicules of bone, and then recommence the treatment of a fracture through the condyles from the beginning, that is, in the fully flexed position. If the function of the joint is satisfactory operation should not be urged for mere æsthetic reasons.

Spontaneous Subluxation of the Wrist (Madelung's deformity) is a condition which occurs in young subjects who have to use their hands freely. It appears to depend on a relaxation of the ligaments which allows the wrist to slip forwards and the head of the ulna to project backwards. In addition to this the lower end of the radius is often curved forwards.

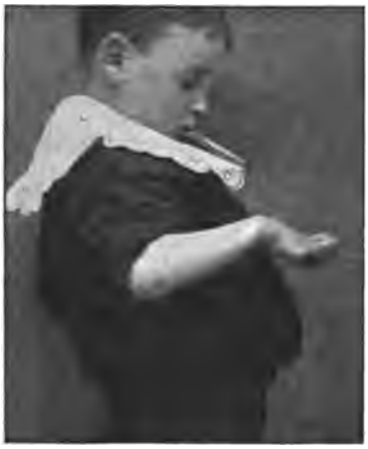

FIG. 2.—Volkmann's contracture.

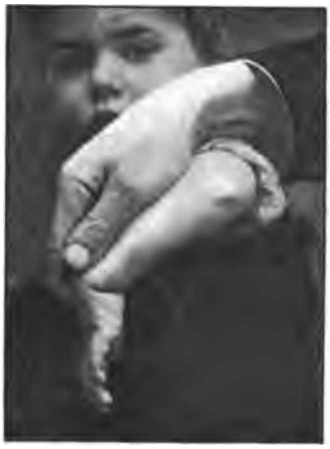

FIG. 3.—Shows how the fingers are extended when the wrist is fully flexed.

Treatment.—First correct the deformity and put the hand and arm in a splint in the hyper-extended position till the slack ligaments have shortened. The test of recovery is that the patient can voluntarily bring the hand into this position. Then massage and make the patient wear a leather mitten with a strap on the dorsum to keep the wrist up. At night the splint is put on again. If the curvature of the lower end of the radius is great it may prevent perfect reposition. In this case osteotomy of the radius should be performed, and the treatment described above carried out after the radius is straightened. The treatment of these cases is always tedious and troublesome.

Volkmann's Contracture or Ischæmic Paralysis is a peculiar contraction of the wrist and fingers described by Volkmann in 1875. The condition is generally attributed to tight bandaging in the treatment of fractures of the arm. The name "ischæmic paralysis" indicates that the trouble is regarded as due to constriction of vessels and interference with blood supply and not to paralysis of nerves. The change that occurs is a myositis associated with contraction and fibrosis of the muscles. The flexor muscles of the forearm are those usually affected. There is obvious impairment of the circulation of the hand. The hand becomes claw-like with flexion at the wrist, slight hyper-extension of the metacarpo-phalangeal joints and contraction of the fingers (Fig. 2). If the surgeon extends the wrist the fingers become more flexed, and if the wrist be flexed it is possible to extend the fingers a little (Fig. 3). The difficulty then is that the flexors are all too short. It is to be noted that the onset is paralysis with contraction. Operations have been devised to meet this in two ways: (1) By lengthening all the flexor tendons in front of the wrist; (2) by excising a portion of the radius and ulna and so shortening the forearm. In either case the contracted flexors must afterwards be stretched, massaged and exercised. We have discontinued any such operative attack and rely entirely on a purely mechanical and manipulative routine.

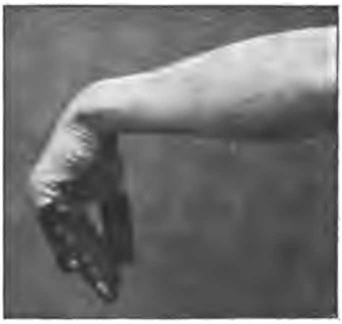

FIG. 4.

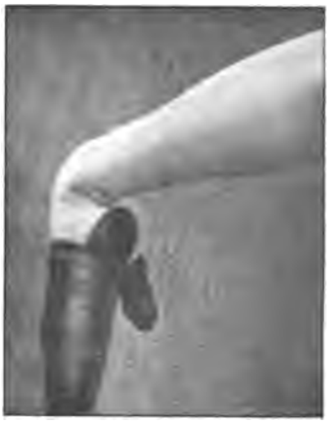

FIG. 5.

Treatment.—It is impossible at once to stretch out the fingers and hyper-extend the wrist on a splint, for spots of pressure gangrene will appear almost at once on the tips of the fingers.

We first cut out five splints of zinc or sheet iron to fit the fingers when extended. An assistant now holds the wrist steadily in full flexion. This relaxes the fingers so that each can be straightened and separately splinted (Fig. 4). The wrist is now released and the patient is directed systematically to attempt to extend the metacarpo-phalangeal range of joints, which are now very contracted; in this he is helped by passive stretching performed by the surgeon. In a few days this can usually be done sufficiently to allow a splint to be applied extending from the finger-tips to the wrist-joint while the wrist is fully flexed (Fig. 5). The hand is now exercised to extend the wrist; after some days a splint can be applied over the others extending from the finger-tips to the middle of the forearm. This is gradually extended at the wrist till the hand is in the position of full hyper-extension (Figs. 6 and 7). This position is maintained for weeks till the elastic resilience is overcome. The splints can then be removed and the hand and forearm massaged, but the splint should still be worn at night.

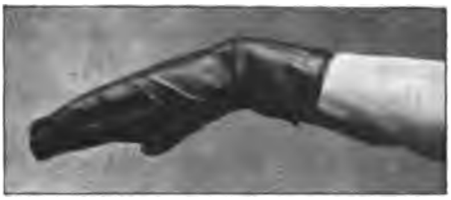

FIG. 6.

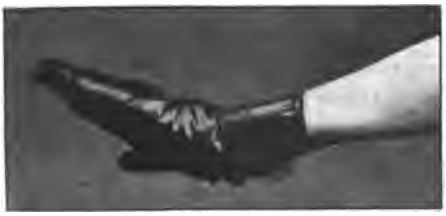

FIG. 7.

The result of this treatment is often most satisfactory. As soon as the hand is fully hyper-extended and the tendency to relapse has been overcome the circulation begins to improve. Even in many cases where the nerves seem to have lost their function this is the starting point of recovery, and the skin begins to recover its normal appearance.

By this treatment the tense structures are stretched in regular order and its advantages over operation are obvious, for it is not desirable to operate on tissues whose circulation is impaired, and an open wound in such tissues is a great hindrance to the necessary manipulation of the limb.

Contractures of the Hand and Fingers. — Cicatricial contractions after burns and injuries are treated in the same way as contracted or club-hand with this difference, that scar tissue is much more difficult to deal with than sound tissue, and plastic skin operations are often necessary. Patient stretching with splints and massage will work wonders in time.

In dealing with such injuries in the first instance time is saved in the long run by preventing the contractures, even though this delays the healing of the wound for a time. The joints should be fixed during the process of healing in a position opposed to the deformity.

Dupuytren's Contraction is due to a slowly increasing contracture of the palmar fascia and its prolongations to the fingers. The ring finger is that most commonly affected, and with it either the middle or little finger is usually more or less involved.

Treatment must be efficient or the condition will recur. The old treatment was to divide tense and thickened portions of the fascia with a tenotomy knife. In most text-books of surgery this is said to be unsatisfactory, for the contraction is apt to recur; hence an open operation to excise all the thickened fascia is advised. We very seldom employ the open method because the subcutaneous method is quite satisfactory provided the after-treatment is properly carried out, and there is then no scar left in the palm, a point of great importance to all who work with their hands. Other objections to the open operation are: (*a*) Contraction of the longitudinal scar in the palm, and (*b*) the difficulty in completely stretching the palm. The after-treatment consists in wearing a finger splint to keep the finger fully extended. This is worn continuously for a fortnight, or until the patient can fully extend the finger voluntarily —the test of recovery. After this the splint is worn at night only for *many months*. This is no hardship to the patient, and neglect of this precaution (not the inefficiency of the method of operation) is the cause of recurrence.

Trigger Finger is the name given to a condition in which one or two fingers do not extend fully when all the fingers are extended, but with a further muscular effort they suddenly extend with a jerk. The same sort of jerk may occur in flexion.

The cause is some thickening in the tendon or its sheath obstructing free movement of the tendon. If of inflammatory origin it may subside with rest on a splint and massage. If persistent the tendon sheath may be explored and the cause removed; operation, however, is not always attended with conspicuous success, for new adhesions or thickenings may form which interfere with function as much as the original condition.

Mallet Finger is a condition in which the terminal joint of a finger is flexed after a blow or injury to the back of the finger which has ruptured or weakened the attachment of the extensor tendon to the base of the terminal phalanx. Such injuries should of course be rested on a splint till the tendon has had time to shorten and recover its function. This injury will not get well unless the terminal phalanx is kept *hyper-extended* for two months. This can be done by a short metal splint which does not prevent free use of the hand.

Incision and suture of the tendon is a last resort, which of course must be followed by a period of rest on a splint. Operation is only required when the tendon is completely ruptured and recovery does not result from a period of continuous splinting. Such cases of failure are extremely rare.

Polydactylism consists in the presence of supernumerary fingers or toes. These may be amputated if necessary.

Macrodactylism is an enormous hypertrophy of one or more fingers or toes. If troublesome they may be amputated.

Syndactylism or Webbed Fingers requires a simple plastic operation to separate the fingers; in the foot no operation is required. If the adhesion consists of a thin web of skin only it may be divided with scissors. If it is thick and fleshy, skin flaps must be taken from the palmar aspect of one finger and the dorsal aspect of the next to cover the raw surfaces when the fingers are separated. The point of greatest importance is to get a good flap of skin into the fork between the fingers to prevent fresh adhesions at this point.

III. CONGENITAL DEFORMITIES OF THE LOWER LIMB.

Congenital Dislocation of the Hip. — This condition has attracted much attention during the last dozen years. It must be carefully distinguished from other affections of the hip, especially from coxa vara, with which it is most frequently confused.

The dislocation is usually backwards on to the dorsum ilii, where a flat false acetabulum is formed. The child walks with characteristic waddling gait, and lordosis of the lumbar spine is a conspicuous feature (Fig. 8).

In later life, between twenty and thirty, patients often complain of aching hips, for the weight of the body is slung from the trochanter by muscles and ligaments which suffer from strain. Movement becomes more limited and the lordosis becomes a source of backache.

It follows, therefore, that treatment should be adopted to avert these after-effects, even if perfect reposition cannot be attained. It will be noted that they depend on the insecure condition of the joint, and on the position of the head being too high up and too far back on the ilium. Such cases should practise hyper-extension movements of the hip-joint and abduction movements. The boot on the affected side can be elevated to disguise the limp and save the patient from the lurch on to the weak hip-joint, and care should be taken to educate the patient in walking.

All early cases and many later cases are amenable to treatment by modern operative and manipulative methods, the credit for which must be given chiefly to Paci of Pisa, and Lorenz of Vienna.

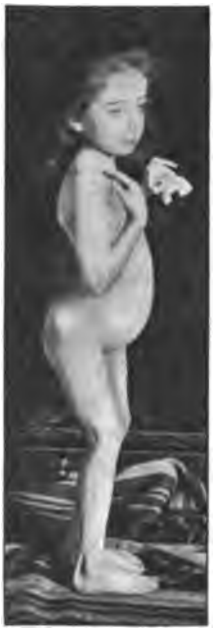

FIG. 8.—Congenital dislocation of the hip.

Paci did not attempt anatomical reposition, though in at least one of his cases this was attained. He aimed at bringing the head of the femur as far down and as far forward on the ilium as possible and allowing the head to make for itself a new false acetabulum near the true acetabulum. His procedure was to flex the thigh on the trunk and the leg on the thigh and then push the knee downwards, abduct the thigh, and rotate the limb outwards so as to force the head of the femur down near the acetabulum. The limb was then extended and pulled till the trochanter came down to Nélaton's line and the head came to a position near the acetabulum. The limb was then fixed in this position.

Prior to 1902 we were in the habit of practising a modification of this operation, and had many gratifying results as regards improvement of gait and correction of lordosis, but they were not cures. Since 1902 we have followed Lorenz's procedure, which aims at an actual anatomical replacement of the head in the acetabulum.

Operation.—The child is anæsthetised.

The thigh is fully abducted, making the abductors tense. These muscles can be ruptured by firm pressure with the thumb or by a sharp tap with the ulnar side of the hand, a manœuvre which requires precision and knack more than force (Fig. 9).

The thigh is flexed on the abdomen and the knee is extended to stretch the hamstrings and structures posterior to the hip.

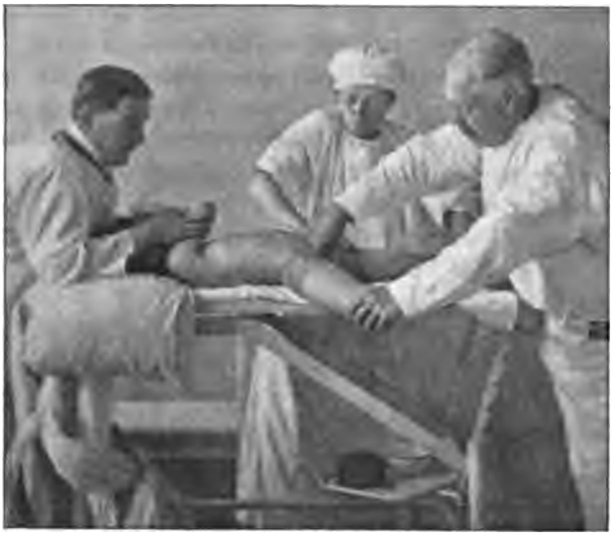

FIG. 9.—Rupturing adductors by pressure with the thumb.

The child is turned face downwards and the thigh hyperextended to stretch structures in front of the joint.

The child is again placed on its back, a sheet folded cornerwise is used as a perineal band and is knotted over the corner of the head of the table. Two or three assistants grasp the limb and pull it either straight down or in a position of slight abduction in order further to stretch structures round the joint. The surgeon

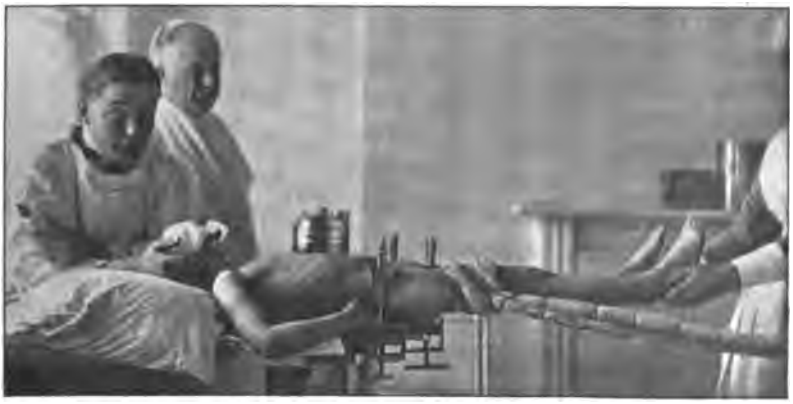

FIG. 10.—Worsted hitch for pulling on the limb to stretch short structures round the hip.

steadies the pelvis with one hand and keeps the other on the great trochanter to note the progress of the head towards the acetabulum. The pulling should be intermittent and not continuous, the assistants swinging steadily forwards and backwards as in rowing, as this is much more persuasive than continuous extension (Fig. 10). When the surgeon is satisfied that the head has been pulled down to the level of the acetabulum, the trochanter having been brought down to the level of Nélaton's line, reposition may be attempted.

The surgeon stands on the same side as the hip to be manipulated. His assistant stands opposite to fix the pelvis. With one hand the assistant grasps the crest of the ilium, the thumb lying along the line of Poupart's ligament, with the other he grasps the tuber ischii in the perineum. Finally, he must keep his wrists and forearms out of the way of the surgeon as he manipulates the thigh. The pelvis being fixed, the surgeon flexes and adducts the thigh across the abdomen, then swings it outwards to lever the head forwards into the acetabulum. He assists this manœuvre by using his other hand as a fulcrum under the trochanter major.

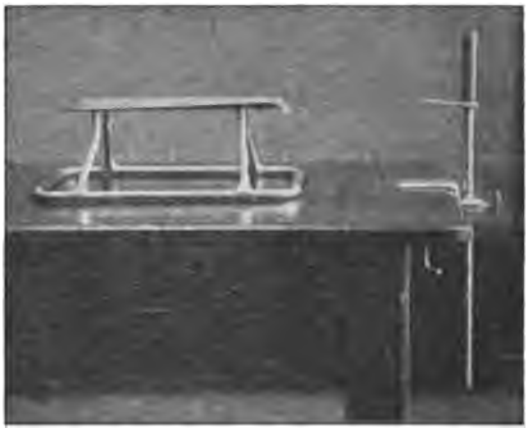

FIG. 11.—Back rest and pelvic support for applying a plaster spica to the hip.

When the head has been successfully replaced on or in the acetabulum, the knee is pressed backwards towards the table with a to-and-fro movement. This pushes the head forwards and helps to stretch the structures in front of the joint.

The child is now placed on a pelvic support (Fig. 11), to have a plaster spica applied. The head must be kept well forward to correct the lordosis, therefore the thigh is abducted with the knee kept well back. To avoid the subsequent external rotation of the limb often resulting from the position originally described by Lorenz, we rotate the femur inwards (Fig. 12), but do not carry the rotation so far as is recommended by Müller. This position is maintained for three months. It is often most convenient to nurse the child at first in the prone position. After three months the plaster case is removed, the limb is brought down to a position of abduction to only 45 degrees and fixed in plaster in this position (Fig. 13). It is at this stage that fracture of the femur is most likely to occur, for after three months in plaster it becomes very fragile, and X-ray photographs show that the density of the bone is reduced (disuse atrophy). Rough handling of the limb must therefore be scrupulously avoided.

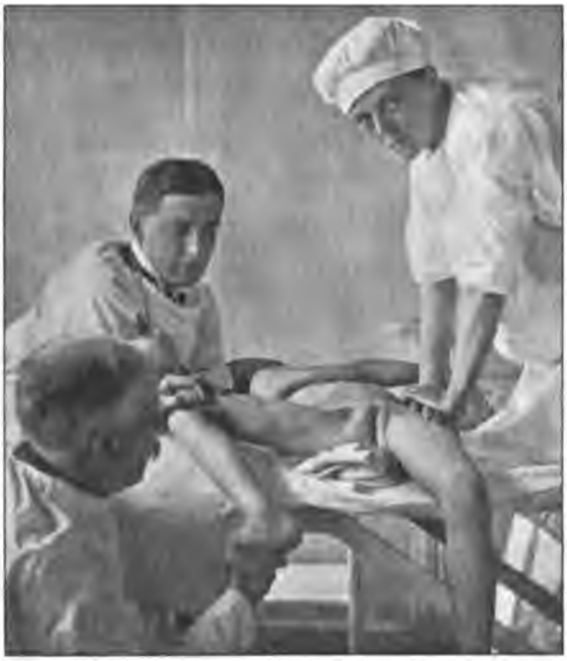

FIG. 12.—Rotating the femur inwards after reposition of the head.

Three months later the limb is brought down parallel with its fellow and again fixed in a plaster spica. Finally, we often allow our patients to walk about in a Thomas' walking calliper (Fig. 14) for some months before allowing them complete freedom. This allows freedom of movement at the hip-joint, while it protects the femur from injury, and it saves the head from being driven upwards, for the splint carries the body weight from the tuber ischii.

If reposition is not attained, the patient is sent back to bed with extension on the limb, and a second attempt is made a week later. It must not be forgotten that the posterior displacement of the head and the consequent lordosis are among the chief causes of trouble in later life, therefore, if anatomical reposition is not attainable because the acetabulum will not retain the head, we aim at an anterior reposition. That is, we fix the limb in plaster in the first position with the head well forward on the mass of bone which contains the acetabulum, and wait for a new false joint to be formed. The functional results of anterior reposition are very good, and it is not always possible to distinguish an anterior from an anatomical reposition by an X-ray photograph. The relation of the head of the femur to the femoral artery is the best means of distinguishing the two, for if the head of the femur is in the true acetabulum the femoral artery is in front of it. In anterior repositions the head is always somewhere external to the artery.

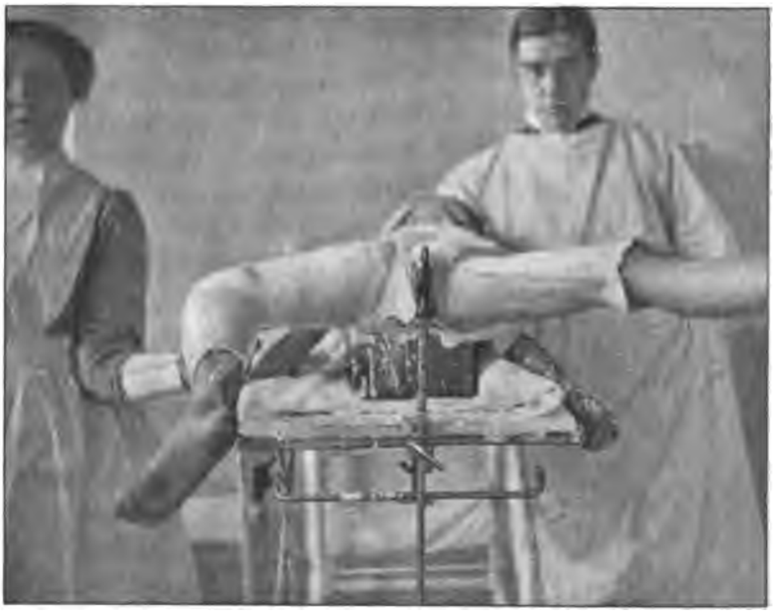

FIG. 13.—The plaster spica applied.

The results of this operation are very satisfactory. Some surgeons claim a very high percentage of cures. We cannot, however, claim more than 60 per cent. of true anatomical repositions in which X-ray photographs indicate that the head is in the acetabulum, and this is confirmed by the position of the femoral artery. The functional result of a good anterior reposition may be practically as good as that of an anatomical reposition, and if we included such cases our statistics would be greatly improved.

Open Operation has been practically abandoned by experienced surgeons in favour of the manipulative method. The incisions usually employed for open reposition were those behind or over the trochanter, commonly used for excision of the hip. Ludloff, of Breslau, has described a new operation from the front and inner side, which he employs for cases in which he has failed to attain anatomical reposition, and is not content with anterior reposition. The child is put up in plaster in the first position for three weeks after the unsuccessful attempt at reposition. Then with the thigh fully abducted an incision is made along the border of the adductor magnus. On separating the muscles this leads straight down to the notch in the acetabulum. The joint is opened in this position and it is generally found that narrowness of the cotyloid ligament has obstructed reposition. The head is now replaced by manipulation, assisted by direct traction with a hook. A good anterior reposition is in our opinion preferable to a reduction by the open method. An exceptionally large proportion of such reductions recur and leave the hip in a worse condition than before.

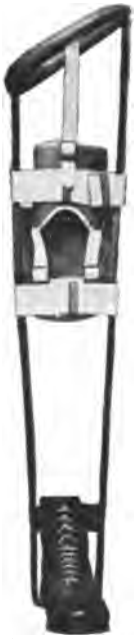

FIG. 14.—Thomas' walking calliper splint.

Congenital Dislocation of the Knee is a rare condition which should be treated by reposition.

Genu Recurvatum is one of the most common congenital deformities of the knee-joint. In this condition the knee is hyperextended and the quadriceps is too short to permit full flexion. The shape of the articular surface of the condyles is modified to correspond with the increased range of movement.

Treatment consists in stretching the quadriceps by flexing the knee under an anæsthetic. The limb is then put up in plaster of paris for a week or two in the flexed position in order to maintain the stretching of the short muscle. After this the patient may walk with a knee cage (Fig. 15) or other appliance which permits flexion but does not allow extension beyond the normal range. In infants all that is required is to keep the knee on a splint in slight flexion for a few weeks. The results are generally quite satisfactory. For paralytic genu recurvatum, *vide infra.*

Contracted Knee may occur as a congenital condition or after inflammations.

The hamstrings, fascia and ligaments behind the knee-joint are all too short. As a rule they can be stretched under an anæsthetic sufficiently to allow a back splint to be applied. After this, patient bandaging and splinting will gradually force the limb into the straight position. Cases where there is actual displacement of the tibia backwards on the condyles (*i.e.*, a partial dislocation) are more difficult, but should be perseveringly dealt with on the same lines.

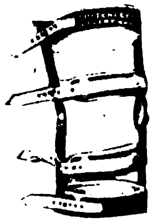
FIG. 15.—Knee cage.

Congenital Defects of the Tibia and Fibula.—Congenital absence of the tibia is fortunately not common, for it is a very disabling deformity. Even partial defects of the tibia are rare. Treatment must be carefully devised to meet each individual case. The limb if curved or distorted must first be straightened; in young children this is easily done by manipulation and splints. In the next place the growth of the defective limb must be encouraged by massage and by fitting the child with a brace which will allow it to walk on the defective limb. If this be done the fibula enlarges and becomes much stronger. Such cases require constant supervision, and every tendency to deformity must be corrected as it arises.

Operative procedure should be deferred if possible till the child is over ten years of age. In a case where the upper end of the tibia was present the upper end of the fibula has been successfully morticed into the marrow cavity of the tibia and a strong limb obtained. At the ankle an ankylosis between the astragalus and fibula may be successful, but few cases if any will be able to do without supporting braces.

Congenital Absence of the Fibula is much more common and much easier to treat. The tibia carries the weight of the body direct from the knee to the astragalus, the fibula acts mainly as an attachment for muscles, and by its external malleolus as an outside support for the ankle-joint. When absent it may be effectively replaced by an outside brace let into the heel of the boot; this is much more secure if there is no joint opposite the ankle (Fig. 17). With this an internal T-strap is worn. The child walks well with this support, and by the time adolescence is reached may have such a strong limb that appliances may be discarded on special occasions, though a brace is always useful as a support to the ankle if walking long distances or over rough ground.

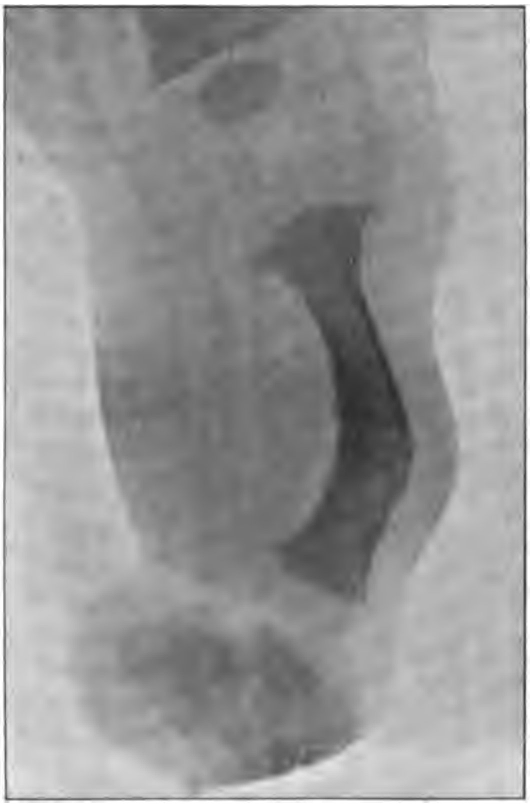

FIG. 16.—Congenital absence of fibula.

With these defects there may be associated defects of toes or of bones of the tarsus and irregular forms of club-foot. The surgeon must exercise his ingenuity in devising suitable treatment in each case, and must remember that the more he can get the patient to use the limb in a good position the better will it grow and develop.

Congenital Club-foot. — There are three main types of congenital club-foot:

(1) Club-foot as part of other congenital defects, *e.g.*, congenital absence of the fibula. Such cases must be treated on their merits.

(2) Club-foot partly paralytic in origin, sometimes associated with spina bifida and other conditions affecting the central nervous system. *Quâ* club-foot the treatment of the third variety applies to these cases.

(3) Simple congenital club-foot is by far the most common type. It is probably due to prolonged retention of the foot in one position *in utero* and persists in virtue of the adaptive changes in bone and soft parts which have resulted.

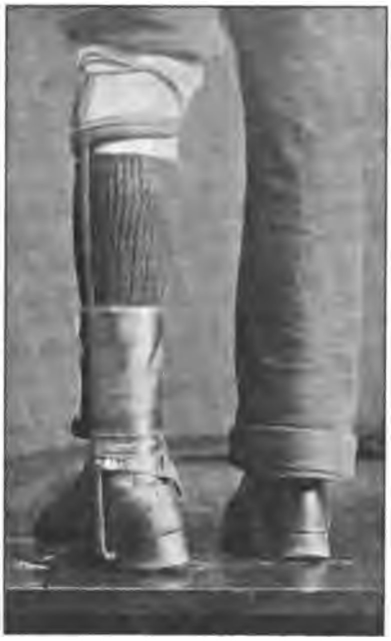

FIG. 17.—A case of congenital absence of fibula after treatment. Showing outside iron and T-strap.

Of this last type the simple forms, equinus, calcaneus, varus and valgus are rarely seen. Combinations are more common and equino-varus is by far the most frequent and the most important variety.

In talipes equino-varus the head and neck of the astragalus are directed more downwards and inwards than in the normal fœtus, the neck moreover is often longer than normal. Further, the foot is adducted and flexed at the mid-tarsal joint so that the articulation of the astragalus with the scaphoid is further to the inner side and under-surface of the head of the astragalus than is normal. The cuboid follows the scaphoid and articulates with the inner part of the front of the os calcis (Fig. 18). All the soft parts on the inner concave aspect of the foot are shortened. Finally, the tibia is often twisted inwards so that the external malleolus lies in front of the internal malleolus instead of in a slightly posterior plane.

When such a child begins to walk the body weight is deflected on to the outer side of the foot and gravity increases the deformity instead of producing the slight changes in the opposite direction, by which the in-toed gait of the normal infant becomes changed into the adult gait with the feet parallel or slightly turned out. This gives the key to our treatment.

Treatment should always be commenced on the day of birth. A month later the case is more difficult to manipulate.

The surgeon grasps the lower epiphyses of the tibia and fibula with one hand and with the other over-corrects the deformity, by abducting the foot at the mid-tarsal joint and extending the foot so as to stretch the short structures in the sole; if the tendo Achillis is short it is stretched as well. This twisting of the foot outwards and upwards should be done with sufficient force to overcome the resilience of the soft parts temporarily. This manipulation is performed for five minutes three times daily, and this is sufficient to correct milder cases in less than two months. It is safer, however, to fix the foot in a small club-foot shoe (Fig. 18*a*) or at least to bandage it in an everted position, the turns of bandage passing from within outwards across the sole of the foot and from without inwards across the front of the ankle. The object of fixation is to relax the weak overstretched structures on the outer side of the foot and allow them to shorten. This daily manipulation must not be omitted until the child can voluntarily bring the foot from the deformed position to a position of complete eversion and dorsi-flexion. This is the test of recovery.

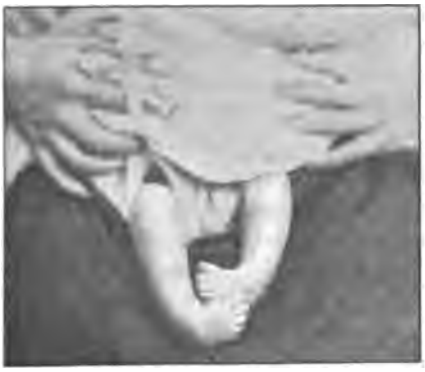

FIG. 18.—Talipes equino-varus.

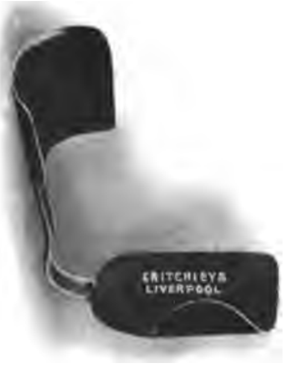

FIG. 18*a*.—Club-foot shoe.

If there be marked inward torsion of the tibia the mother must be taught to grasp the leg firmly below the knee with one hand and just above the ankle with the other, and firmly screw the lower end outwards several times daily. If this does not completely cure this element of deformity by the time the child begins to walk a bar should be fixed along the outer border of the sole of the boot (Fig. 19). This everts the foot and so produces an increased outward torsion on the tibia.

If this treatment were uniformly adopted and efficiently executed from the day of birth there would be no congenital club-foot in children over two months of age, and we should no longer read in text-books that talipes equino-varus is a "most intractable form of club-foot."

In cases where the child is six weeks old or more the foot has become so stiff that a wrench may be necessary to correct the deformity, and tenotomy of tense structures may be desirable. In all cases of forcible manipulation of the foot, as with Thomas' wrench, the lower epiphyses of the tibia and fibula must be firmly grasped to guard them from strain. In using Thomas' wrench the foot must be firmly grasped by the jaws of the wrench, for if it slip the skin may be injured. The wrenching movements are made quickly and forcibly and the wrench immediately relaxed. By a succession of such movements the deformity is rapidly overcorrected. In the same way, when using the wedge, a succession of rapid movements are more effective than prolonged efforts, and they do not bruise the foot so much (Fig. 20).

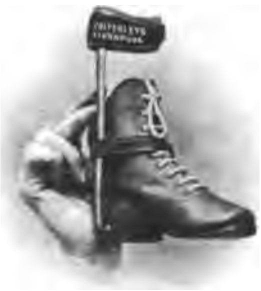

FIG. 19.—Bar on outside edge of sole and inside brace for club-foot.

Some cases may require to be wrenched several times at intervals of two days; in the intervals they should be fixed in a club-foot shoe. When over-correction is complete the foot may with advantage be put up in a plaster case in the fully over-corrected position; though we generally use a modification of Thomas' club-foot shoe. There is no harm in the child walking in the plaster case, for if the deformity is fully over-corrected gravity will help to maintain the correction. The test of recovery is the restoration of the patient's power to correct the deformity voluntarily. The child may then walk in a boot with a bar along the outer side of the sole and with an inside brace and outside T-strap.

Tenotomy of the plantar fascia and spring ligament is a useful preliminary to wrenching in stiff cases, for it permits correction at one sitting in cases which would otherwise require several wrenchings. We use strong tenotomy knives with a short cutting edge (Fig. 21).

(*a*) To divide the plantar fascia the knife is entered at the inner margin of the sole with the foot relaxed. The edge is directed towards the toes, and with the flat of the blade parallel to the surface the knife is pushed in under the skin till the cutting edge is over a band of fascia. The edge is now turned up and the fascia made tense by extending the foot. The fascia then parts over the edge. The fascia is thus repeatedly scored in several places wherever a tight band is felt. The knife is not withdrawn, so that there is only one skin wound. After this the fascia yields readily to wrenching.

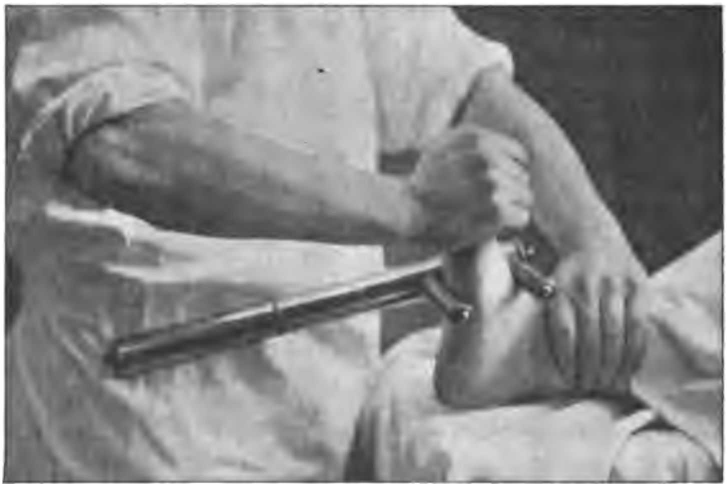

FIG. 20.—Thomas' wrench in use. The surgeon works the wrench with his hip, leaving his hands free to guard the epiphyses and steady the foot.

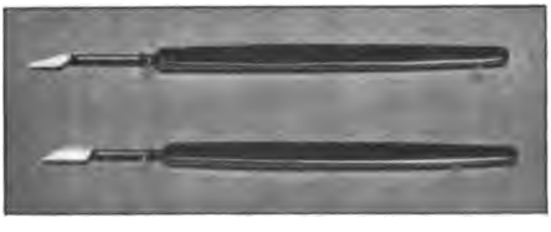

FIG. 21.

(*b*) To divide the inferior calcaneo-scaphoid ligament. In cases of club-foot a distinct triangle can be seen on the inner side of the instep. At the apex of this triangle the knife is entered with the

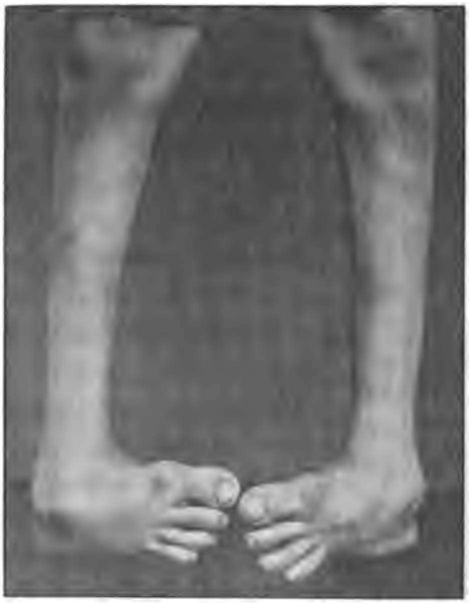

FIG. 22.—Case of neglected club-foot.

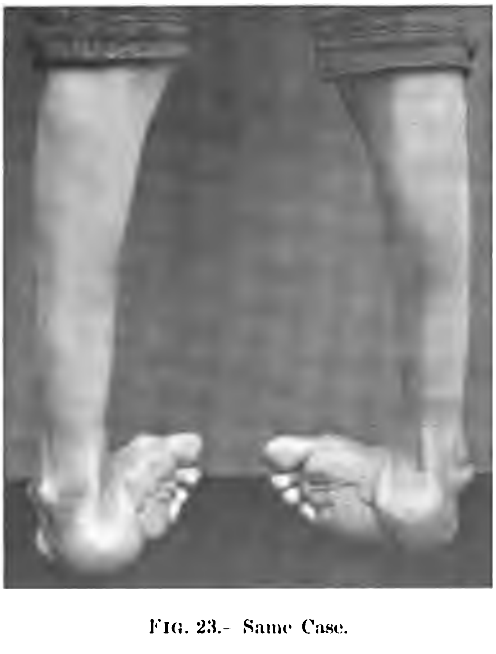

FIG. 23.—Same Case.

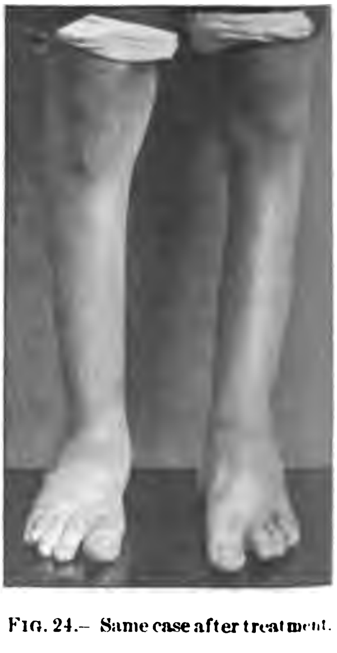

FIG. 24.—Same case after treatment.

edge towards the toes, and is pushed straight outwards between the ligament and the plantar vessels and nerves which are superficial. The edge is now turned up and the tense ligaments are divided by extending the foot.

(*c*) The tendo Achillis should never be divided till all wrenching of the foot is finished, for it gives a useful resistance against which to stretch structures in the sole.

Some surgeons, following Phelps, of New York, advocate an open operation dividing all structures on the inner side of the foot. The deformity is then corrected and the wound left open to heal by granulation, a process which takes about three months. The patient is exposed to the risks of sepsis, and in our opinion the operation is badly conceived and unnecessarily severe and comparatively ineffective.

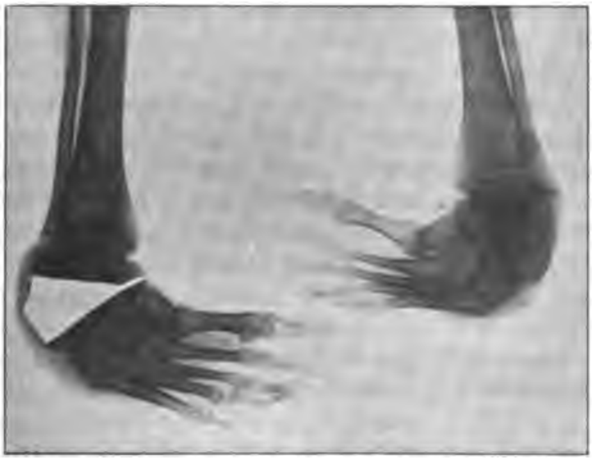

FIG. 25.

Operations on Bone.—(*a*) *Operations on the Tarsus:* In old neglected cases the bony changes are so great that there is no hope of getting the patient to walk on the sole of his foot without removal of a wedge of bone.

As removal of bone means a shorter foot, no operation should be performed before the foot has been most thoroughly wrenched and the maximum correction short of operation has been obtained. In this way removal of unnecessarily large portions of bone is avoided (Figs. 22—24).

We usually remove the distorted head and neck and all the lower part of the astragalus, leaving the surface for articulation with the tibia. We then perform a linear osteotomy through the rest of the tarsus and correct the deformity (Fig. 25).

(*b*) *Operation on the Tibia.*—In infants the internal torsion of the tibia may be corrected by manipulation. In older cases where this deformity is present osteoclasis at the junction of the middle and lower thirds of the tibia is required. The lower part is screwed outwards through the necessary angle, and the case is treated as a fracture.

It must be remembered that walking is the necessary factor to complete the cure of club-foot.

IV. ACQUIRED DEFORMITIES OF THE LOWER LIMB.

In dealing with deformities of the lower limb, it is necessary to appreciate the manner in which the body weight ought to be transmitted to the ground through the hip, knee and ankle-joint, and finally through the arches of the foot.

In a normal subject standing erect with the feet slightly separated the hip, knee and ankle-joints are in a vertical line. The centre of the ankle-joint is well within the triangle formed on the ground by the heel and the heads of the first and fifth metatarsals. This forms the base of support. Any deviation of the body weight out of this line throws abnormal strain on ligaments and on growing epiphyses, and leads to deformities produced according to Wolff's law in the internal structure and in the outward conformation of the bones, such as are seen in knock-knee, flat-foot and other conditions. It will be shown in succeeding sections that deflection of body weight can be used as a method of treatment to correct erroneous tendencies in growing bone in the same way as erroneous deflection may produce them.

Coxa Vara is a pathological diminution of the angle between the axis of the neck and that of the upper end of the shaft of the femur. It may be traumatic in origin, being due to a mal-union of a fracture of the neck. In this connection we may state that the importance of treating all fractures of the neck of the femur in an abducted position is not sufficiently recognised. It has now been proved that fracture of the neck of a greenstick type may occur in young children and be entirely overlooked, and these cases furnish some of the examples of coxa vara. The causes of ordinary coxa vara are to be found in any condition of weakness of the bones, associated sometimes with rapid growth and increase in weight. Thus any inflammatory or infective condition affecting the neck, such as epiphysitis or rickets, in which there are increased vascularity and osteoporosis, leads to yielding of the neck to the superincumbent body weight, the neck bending downwards and backwards. Very mild rickets in infancy when a child is learning to walk may produce a slight degree of the deformity not sufficient to be noticed, but when the child gets to the next period of rapid growth (ten to fourteen in girls and fourteen to eighteen in boys) this slight deviation becomes more marked, for the rapid growth of the epiphysis leads to weakness of the femoral neck, already a little out of its normal line, at a time when body weight is rapidly increasing. Hence coxa vara is recognised at two periods, either as a rachitic condition in childhood or as a growth deformity in early puberty, possibly associated with previous rickets.

Treatment.—(1) Non-operative treatment is effective in all early cases, especially if the condition producing the deformity is still active. That is to say, if the bone is still rather soft, it is easier to correct the deformity. The patient is put on his back, with the thighs well abducted and rotated inwards, and extension is applied. This relieves the yielding neck of the distorting body weight, and extension in the position described is obviously corrective. We fix the patient in an abduction frame. The second stage of treatment consists in the use of a walking calliper (Fig. 14), which permits the patient to walk about and exercise the limb without bearing weight on the neck of the femur, for the splint supports the body from the tuber ischii.

(2) Operative treatment is required in severe cases where the bony deformity has become consolidated. The operation required is simple linear osteotomy or cuneiform osteotomy below the great trochanter. Rotation is corrected and the limb put in the abducted position already described. The after-treatment consists of massage and exercise when the bone has united.

Coxa Valga is the opposite deformity, the neck making a greater angle than normal with the shaft of the femur. It is usually associated with some condition in which the body weight is not borne on the head of the femur in the usual way, as in paralysis of the limb or congenital dislocation of the hip. It is not often of practical importance from the point of view of operative surgery.

Genu Valgum or Knock-knee is caused by erroneous deflection of the body weight, together with a disproportion between the weight to be carried and the strength of the bones and ligaments. As the patient stands with knees together the feet are separated by a space, it may be of several inches. The vertical line from the hip-joint falls outside the knee-joint and inside the foot which is everted. Thus undue strain is thrown on the internal ligament of the knee and on the inner arch of the foot. Hence knock-knee and flat-foot are closely associated, and the examination of a case of knock-knee is not complete till the foot has been examined for flat-foot, and *vice versâ*. On examining the knee the internal condyle seems prominent, but a more careful examination or an X-ray photograph will show that the lower end of the shaft of the femur is bent inwards, just above the epiphyseal cartilage (Fig. 26). If the surgeon now grasps the lower end of the femur with one hand, and with the other straightens the knee, he will be able to move the leg laterally with the leg in full extension. This movement is quite abnormal and is an indication of the stretched condition of the lateral ligaments. This lateral movement is of great importance, for it is the first sign to appear in commencing genu valgum and is the last to disappear. No case of genu valgum can be declared cured till lateral movement has disappeared, for so long as the ligaments are slack it is possible for the knee to assume a position which will lead to recurrence from erroneous deflection of body weight.

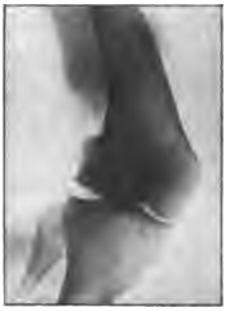

FIG. 26.

Treatment consists of: (1) Deflection of body weight so as to take all strain off the internal ligament of the knee; (2) wearing a brace to keep the knee out while bones and ligaments become adapted to the corrected position; (3) operation to correct gross deformity of bone, as a preliminary to the former treatment.

(1) Incipient cases will often be cured by deflection of the body weight alone. The patient must be compelled to walk with toes turned in. This can be done by altering the heel of the boot so as to throw the body-weight on to the outer side of the foot. Young children are often brought to us with the complaint that they are turning their toes inwards when walking, and wearing down the outside of the heel and sole. On examination such cases are nearly always found to have lateral movement of the knee, or have signs of commencing flat-foot or both. The child instinctively tries to relieve the strained ligaments by getting on to the outside of the foot. By crooking the heel we help this natural attempt at cure.

(2) In cases with marked lateral movement at the knee, the ligaments being much stretched, or when the end of the shaft of the femur (more rarely of the tibia) is curved inwards from bending of soft bone newly formed by the epiphyseal cartilage, an altered boot is not sufficient. Such cases must wear a knock-knee

brace, which consists of an outside bar from the trochanter to the heel of the boot, and a posterior bar from the gluteal fold to the lower third of leg. When the knee is bandaged to this it is kept outwards and slightly backwards (Fig. 27). The heel of the boot is altered as before. This splint must not have a joint at the knee or the child will walk with the knees slightly flexed and nullify the corrective action of the splint. The brace must be worn until all signs of lateral movement at the knee have disappeared, *i.e.*, till the ligaments have recovered and the body weight is being transmitted in a vertical line through the knee. The altered heels are continued for some months to guard against recurrence.

(3) Operative treatment is required in all cases where the deformity of bone is pronounced or fixed, and cure is not to be expected within a reasonable time by imposing a corrective strain on the growing bone. The main deformity is generally in the lower end of the femur, rarely in the upper end of the tibia. The usual operation is osteotomy of the femur above the epiphyseal cartilage and treatment of the case as a fracture with correction of the deformity.

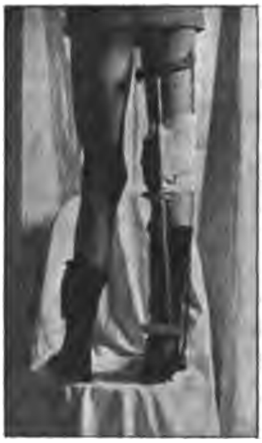

FIG. 27.—Knock-knee brace and "crooked" heel.

Operation.—The sulcus at the outer border of the vastus externus can always be seen, a point in this 1½ to 2 inches above the condyle is well above the epiphyseal cartilage. Linear osteotomy may be performed with a modified Adams' saw. A broad scalpel is plunged right down on to the femur and the periosteum incised for ½ inch; a periosteum detacher is passed down the blade of the knife to elevate the periosteum across the front of the femur. The saw is passed down the side of the elevator and the bone is sawn nearly through and then broken. One stitch suffices for the skin wound. The fracture is then treated in a Thomas' knee splint with good extension, pads being applied as in the diagram to correct the deformity (Fig. 28). At the end of four to six weeks the patient walks in a walking calliper, with the heel of the boot altered, till the fracture is safely united, when a knock-knee brace is worn and the after-treatment is that given above. All that is required is to bring the line of the bones into the true line of transmission of body weight and keep them there, then wait for nature to complete the cure by adaptive growth.

Bow-leg and Genu Varum are not strictly the same condition, for in the former the bow is mainly in the tibia and fibula and in the latter it extends across the knee, affecting both the femur and the bones of the leg. The treatment of bow-leg, with slight modifications, applies to bow-knee or genu varum. We shall therefore describe it first. The condition is generally rachitic in origin. In addition to the lateral bow there is usually some anterior bowing (anterior bow-leg).

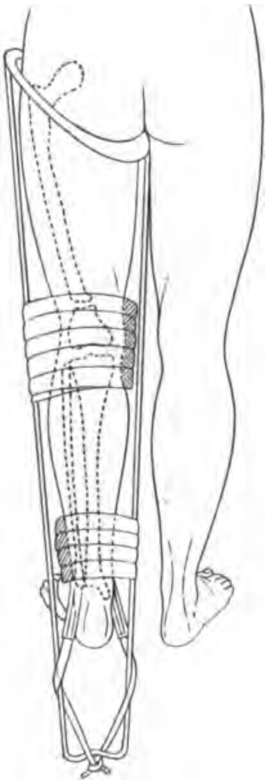

FIG. 28.—Use of Thomas' knee splint after osteotomy of femur.

Treatment.—Make the leg straight, so that the body weight is transmitted vertically downwards through the tibia.

(1) In the active stage of rickets the child must be treated as described in Section V., p. 970. The bone is soft enough to be moulded by hand, producing at most a greenstick fracture.

(2) If the stage of active rickets is past, the bones are harder and must be broken. This may be done by osteoclasis by hand up to the age of four or five, and by the osteoclast up to seven or eight. For those not in the habit of performing osteoclasis osteotomy is more satisfactory. Whether the limb is moulded or fractured splints must be carefully applied. A pad is applied over the summit of the curve at which the bone is made to yield or is broken. Two pads are applied on the inner side, one just below the tuberosity of the tibia, and one above the internal malleolus. Lateral splints must be applied to control the limb absolutely or the limb must be accurately put up in plaster. We employ sheet-iron splints in all cases, for they fit the limb more closely and can be applied more firmly than an unyielding wooden splint, without fear of producing pressure sores. In all cases of osteotomy of the tibia the fibula must be broken as well; in some cases which can be corrected by hand the fibula will yield without complete fracture.

After-treatment consists in the application of a bow-leg brace on the inner side of the limb. The object of treatment is to get the hip, ankle, and knee in one line which passes down the axis of the leg. If this is secured future growth will correct minor irregularities, of which slight anterior bow-leg is one. If the lateral deformity is properly corrected it is very seldom necessary to operate for the anterior bow.

In very pronounced genu varum it may be necessary to operate on both femur and tibia, as operation on the tibia alone may result in a genu valgum. The brace worn must be a long brace. Its action is the opposite of that used for knock-knee. It should not have a joint at the knee, or the child will bend the knee and so avoid the corrective strain at the knee. As in the case of knock-knee mild cases in an actively growing child can be corrected by the brace alone.

Pes Cavus, Pes Arcuatus (Hollow or Contracted Foot).—In some persons the arch of the foot is naturally higher than is usual, and this is looked on more as a point of beauty than as a deformity. The chief disadvantages of a physiologically abnormally high arch are the difficulty in getting suitable boots, and the fact that these persons suffer most intense pain should the ligaments of the arch be strained as in the initial stages of flat-foot.

As a pathological condition ordinary pes cavus or hollow foot is usually secondary to some transient paralysis which may have occurred after diphtheria, scarlet fever, influenza or some other acute infective condition, or in women as a secondary result of the persistent use of high heels. The primary fault is weakness of the extensor muscles, the secondary is contracture of the structures in the sole of the foot. What is generally known as "paralytic" pes cavus is a condition associated with obvious paralysis of certain muscles, and is dealt with in the section on Paralytic Deformities.

The type now under discussion is frequently seen in connection with paralysis of the type of Friedreich's hereditary ataxy and Tooth's paralysis. Though some of these cases are progressive the progress is often slow and sometimes becomes arrested; it is therefore always worth while to treat the cavus and so make the best of the foot as an organ of progression.

The treatment in accordance with the general principles we have already laid down is fairly obvious. The contracted structures in the sole must be stretched, or, if necessary, divided, and then the weak extensor structures must be given an opportunity to recover. The test of recovery is the return of the power of full voluntary dorsi-flexion of the foot.

The structures in the sole are dealt with as in the treatment of congenital club-foot, by manipulation, wrenching, and, if necessary, tenotomy of any specially strong bands in the plantar fascia. The foot is then moulded into a flatter shape and put up in plaster, or in many cases it is sufficient to strap the instep well down to the sole plate of a club-foot shoe. When boots are worn after preliminary treatment in splints they should be roomy in the forepart to allow the toes to stretch; the sole should be flat and stiff and the heel low. At night the patient binds the instep down to a club-foot shoe, for the feet have a tendency to contract during sleep. The condition is apt to recur unless the patient is warned to continue to wear the splint at night for a long time and to resume its use on the slightest sign of recurrence of the contraction.

It is necessary to give a word of warning with reference to operation on the tendo Achillis. In these cases, although the toes are rather in an equinus position, the heel is not drawn up, but is more often depressed, as in paralytic drop-foot. If any operation on the tendo Achillis is required it is usually a shortening of the tendon rather than a tenotomy, which is so often erroneously performed.

Metatarsalgia, Morton's Neuralgia, or Plantar Neuralgia.—The condition originally described by Morton (1876) was one in which the patient experienced pain in the fourth metatarso-phalangeal joint, with radiating pain up the leg and into the toe. A precisely similar condition may occur in the second and third toes, but it much more frequently affects the fourth toe.

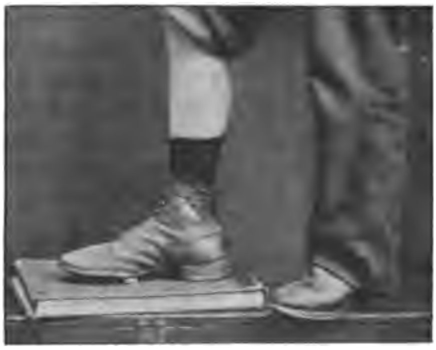

FIG. 29.—Bar on sole behind heads of metatarsals to relieve pressure in Metatarsalgia, or Hallux Rigidus.

The condition depends on weakness of the transverse arch of the foot, and this is usually associated with yielding of the longitudinal arch. It may therefore follow an injury of the foot or result from weakness of the muscles of the foot, as in cases where tight shoes have been worn. This leads to disuse of the small muscles of the foot, the fifth metatarsal is crowded on to the dorsum of the fourth, which is pressed down into the sole. Morton attributed the condition to compression of the nerves between the metatarsals, but we are of opinion that the true explanation is to be found in pressure on the plantar nerve in the sole.

Treatment.—(1) Milder cases are relieved by a strip of plaster fixed firmly round the metatarsals near their bases. The patient must for some months wear a roomy boot with a strong flat sole, having a bar across it just behind the heads of the metatarsals, to relieve pressure on the painful spot when walking (Fig. 29). The patient must practise flexion movements of the toes to strengthen the small muscles in the sole and restore the arch.

(2) In severe cases the only course is to excise the metatarsal head by a short dorsal incision. For some time afterwards the patient wears the boot described above. This operation is as effective as it is simple.

Metatarsalgia may occur in several generations of a family. It is more common in women than in men. The former are more addicted to the use of narrow shoes and high heels, which cause dorsi-flexion of the toes and loss of power in the foot.

Hallux Rigidus or Hallux Flexus (Davies-Colley) is a condition marked by pain and limitation of dorsi-flexion in the metatarso-phalangeal joint of the great toe. The onset is insidious; at first there is limitation in dorsi-flexion which causes pain in walking, later there is plantar flexion and pain is severe. It may arise from an injury, such as "stubbing" the toe, but is much more frequently associated with "weak foot" or commencing flat-foot.

Treatment.—First, treat the tendency to flat-foot (*vide infra*); second, rest and relieve the joint by a splint (Fig. 30), applied along the inner side of the foot, which slightly adducts the toe and guards the joint from strain; third, the boots must be straight on the inside with a stiff sole, and a bar should be placed on the sole behind the head of the metatarsal to relieve pressure.

For operative treatment, *vide* Hallux Valgus.

Hallux Valgus.—In this condition the great toe is in an abducted position. The metatarso-phalangeal joint forms a prominence on the inner side of the foot and is usually surmounted by a bunion. Some degree of this deformity is so common that few people are aware that in the normal foot a straight line drawn through the axis of the great toe should pass through the centre of the heel (Myer's line). All boots ought therefore to be made straight on the inside, and not trending outwards in front of the ball of the foot as is usual.

Treatment.—In cases which are not too far advanced the patient should wear the splint shown in Fig. 30 at night, and in the daytime wear socks with a separate compartment for the great toe. A toe-post fitted in the boot to keep the great toe away from the others may occasionally prove useful.

Operation.—The same operation is applicable to both hallux rigidus and hallux valgus. An incision 1½ inches long is made on the inner side of the foot over the head of the metatarsal and the joint. The joint is opened and the head of the metatarsal is cleared with a blunt dissector. The whole of the head and nearly ½ inch of the neck of the bone is then removed with bone forceps. The tendency is to remove too little bone. A purse-string suture is then run round the soft parts so as to cover in the raw end of bone. Charles Mayo makes an internal flap, including the bursa over the head of the bone, and after removing the head, draws the bursa in between the end of the metatarsal and the phalanx with a buried suture. The wound in either operation is closed without drainage. The splint already described is applied. Even after the operation bursitis may occur.

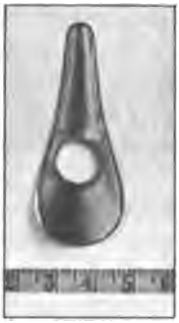

FIG. 30. -- Hallux Valgus or Rigidus splint. The hole in the splint is to accommodate the tender metatarso-phalangeal joint.

Hammer-toe usually affects the second toe, which is dorsi-flexed at the metatarso-phalangeal joint and flexed at the first inter-phalangeal joint. There is frequently a corn on the tip of the toe, another under the head of the metatarsal, which is forced down out of the transverse arch, and a corn or bursa on the knuckle, which projects on the dorsum. Hammer-toe may be congenital or hereditary, but is usually due to tight boots. It is frequently associated with hallux valgus, as the abducted great toe crowds the second toe out of position.

Treatment.—(1) Mechanical: Proper boots should be worn, and any tendency to hallux valgus should be treated. The hammer-toe is straightened out and fixed to a light metal splint to keep it straight. This can be worn inside the boot.

(2) Operative: In severer cases which cannot be straightened by the above means the first interphalangeal joint must be excised and the bones must be ankylosed, otherwise the condition recurs. The splint shown above is then applied. This operation is preferable to amputation, for hallux valgus is apt to follow the latter operation. In excising the joint we make an oval transverse incision over the prominent knuckle, entirely removing the corn or bursa if present. When this skin wound is stitched up the skin on the dorsum of the toe is shortened and helps to keep the toe straight. After excising the joint the capsule on the plantar aspect and the flexor tendon should be divided.

In some cases of medium severity division of the flexor tendon and of the plantar ligament of the joint with a tenotomy knife, followed by treatment on the splint, is perfectly satisfactory.

Weak Foot, Everted Foot and Flat-foot.—Like the conditions of the feet which we have just been considering, flat-foot depends in large measure on the use of tight and improperly shaped boots, which set the laws of anatomy at defiance and assist the pernicious action of erroneous deflection of body weight.

The natural strength, suppleness and spring of the foot depend on the preservation of the longitudinal and transverse arches of the foot, and these in turn depend on the strength of muscles and ligaments. If the foot is habitually enclosed in a tight-fitting boot which limits the play of its muscles, these naturally become weak from disuse, and it requires very little abnormal strain to make the arches of the foot give way. The importance of the breadth of the forepart of the foot is tacitly admitted by every man who buys broad shooting or climbing boots, even though he may wear stylish narrow boots in town. It must be remembered that the foot is a half dome, the two feet side by side forming a dome. Each foot rests on three points of support, and like all tripods its stability depends on the basis of support being broad. The type of boot commonly worn shows a total disregard for the anatomy and mechanical structure of the foot. The whole inner side of the boot should be straight (Fig. 30*a*), while in the form in common use the inner side deviates outwards towards the point of the boot. This produces abduction of the great toe and abduction at the mid-tarsal joint, and brings the two anterior points of support too near together. The weight of the body falls too far to the inner side of the triangle of support, and the foot is necessarily submitted to an undue strain on its inner side. The ligaments and muscles which support the arch give way, and what is known as flat-foot is produced.

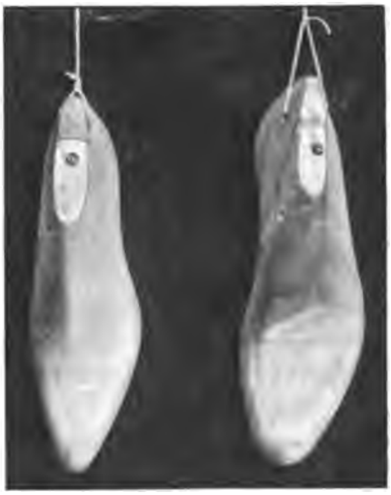

FIG. 30*a*.

"French" last.

"American" last, which is much straighter on the inside.

Clinically three main varieties may be recognised: (1) Painful foot, in which there is no very evident deformity or sinking of the arch, is the initial stage often diagnosed as rheumatism; (2) painless flat-foot, in which the arch has sunk, the ligaments are stretched, but the foot has adjusted itself to its new conditions; there is no pain, but the foot is stiff, the gait is clumsy, heavy, and without spring; (3) painful flat-foot is an acute condition; the arch has descended, all the ligaments and joints of the tarsus are painful and acutely tender to touch, and the skin often is hyper-æsthetic.

(1) The initial stage should never be mistaken for rheumatism. A diagnosis is made by pressure on the inferior calcaneo-scaphoid ligament just under the tubercle of the scaphoid. Tenderness in this locality indicates that the ligament is being stretched and that the initial stage of flat-foot is present. Pain in the same place when the foot is passively everted is confirmatory evidence.

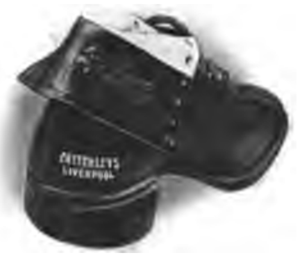

FIG. 31.—"Skewed" heel. The heel projects ¼ in. on inner side to give a broad base of support, and is ¼ in. higher on the inside than on the outside.

Treatment.—Just as the condition is determined mechanically by eversion and abduction of the foot at the mid-tarsal joint, together with deflection of the body weight to the inner side, so the secret of treatment lies in inversion and adduction, and deflection of the body weight from the inner to the outer side of the foot. The boots must be straight on the inner side and wide enough to let the forepart of the foot spread out. The heel is "skewed," *i.e.*, it projects on the inner side of the boot to get a wider base, and is thickened on the inner side to deflect the body weight from the inner to the outer side of the foot (Fig. 31). A wedge of leather is put under the ball of the great toe. This helps to throw the anterior part inwards and compel the patient to walk with the toes slightly turned in. If necessary, an outside leg brace may be added with a T-strap on the inner side, which, when buckled round the brace, draws the ankle outwards and adds greatly to the comfort and sense of security of the foot. Skewed heels are useless unless the boot has a strong firm sole, well beaten on a flat last.

Exercises for flat-foot are as simple as they are effective. The patient should never stand unless he is wearing boots or slippers with the heels altered, *i.e.*, he never strains the over-stretched structures: (*a*) While sitting he practises flexion and extension exercises of the toes, circumduction and especially inversion of the foot; the latter may be practised against resistance to strengthen the tibial group of muscles; (*b*) wearing the altered boots, the feet are placed parallel to one another, and the patient rises on tip-toe, turning the knees and ankles outwards so as to rise on to the ball of the little toe, not on to that of the great toe; (*c*) walk round the room on the outer side of the foot.

Many of these cases are round shouldered and slouch forward when walking, and therefore ought to have general setting-up drill in addition.

Massage affords great relief in the painful stages and is a useful adjunct to exercises in all stages.

(2) In the second type, in which the arch has given way and the flat-foot has become fixed, the deformity is first corrected by wrenching the foot under an anæsthetic. The foot is then put up in plaster for ten days in the fully inverted position. This allows the soft parts to adjust themselves to the corrected position. After this the patient wears the boot described above and is put through a course of massage and exercise.

(3) In the third type the foot is almost too painful to be touched. The patient rests in bed and has light massage for a few days. The foot is then less painful, and may be inverted and put up in plaster for ten days or a fortnight in the fully inverted position to let all inflammation subside and allow stretched structures to shorten. After which altered boots are worn; at first a limited amount of walking is permitted, with daily massage and exercises. These cases are always acute and of rapid onset. The patient may have had more or less pain in the feet for some time; then some debilitating cause, such as an attack of influenza, so weakens the patient that the arch rapidly gives way. Hence, in these cases, general tonic treatment and graduated exercises for the whole body are of importance to secure a good result.

Inflammatory Flat-foot.—Flat-foot, secondary to arthritis or gonorrhœal peri-arthritis, is really a static condition, and is to be treated in the same way. During the stage of acute inflammation all the ligaments are congested, sodden with lymph, and therefore soft and weak. If the patient tries to walk they necessarily stretch. The acute condition passes off and the patient recovers with a stiff flat-foot, corresponding to the second type described above. Thorough wrenching under an anæsthetic to break down all adhesions, inversion, rest in plaster, and the use of a boot with skewed heels will bring about a cure.

Traumatic Flat-foot.—Flat-foot following crushes and severe sprains of the tarsus is treated exactly as the condition just described.

Flat-foot, secondary to a mal-united Pott's fracture, is unfortunately a common condition. It is due to failure in maintaining full inversion when treating the fracture. Here, again, eversion of the foot and deflection of the body weight to the inner side is the primary fault, but it is situated at the seat of fracture as well as at the tarsus.

Treatment.—The only treatment after the fracture is firmly united is to cut a wedge from the inner side of the tibia above the malleolus, break or divide the fibula, and invert the foot. The patient then wears a boot with altered heels, an outside brace and inside T-strap to support the ankle. These cases recover slowly and often complain of pain about the ankle for months, but if the treatment is persevered with ultimate recovery is assured.

Springs and plates to be worn inside the boot are often used with a view to holding up the arch. We consider them entirely wrong in principle. Descent of the arch is an effect resulting from eversion at the mid-tarsal joint, cramping of the foot and weakness of muscles and ligaments of the foot, and of the tibial group of muscles. These muscles have yielded to undue strain caused by erroneous deflection of the body. To secure a cure these muscles must be relieved of strain by deflecting the body weight on to the outer side of the foot, and their strength must be restored. Plates which artificially hold up the arch compress the muscles and ligaments in the instep between the plate outside and the bones of the tarsus inside, and therefore prevent these structures from recovering tone and strength, which is essential to a cure of the condition.

It should be noted that a foot which cannot be placed in inversion manually is not suitable for mechanical correction by boot or splint. Division of the tendons of the peronei muscles, forcible inversion and retention in the corrected position are indicated.

V. RACHITIC DEFORMITIES.

Although we have dealt with individual deformities of rachitic origin, such as bow-leg, in other parts of this article, we think it desirable to devote a short section to the surgical aspect of acute rickets.

Rickets is a general disease associated with impaired nutrition and metabolism, in consequence of which all muscles in the body are weak; there are cases of rachitic pseudo-paralysis; all ligaments are soft and stretched; every joint in the body is slack; the epiphyseal cartilages lay down irregular and imperfectly ossified bone; the long bones are soft and yield to strain, and the epiphyseal ends become thickened. It is generally recognised that the child should not be allowed to walk, and should be put on proper diet and medicinal treatment.

The point we wish to emphasise is that merely putting the child to bed is not sufficient to prevent deformities from being produced. The child habitually sits in the corner of its cot with the legs crossed, a position which produces bow-leg and curved femora, with the shoulders bowed forward and the weight of head and shoulders partly supported by the arms, a position which produces curvature of the long bones of the arms, kyphosis and round shoulders, and Harrison's sulcus across the lower part of the chest. Pot-belly is an indication of weakness of the abdominal parietes, all the contents of the abdomen being pushed down in such a position.

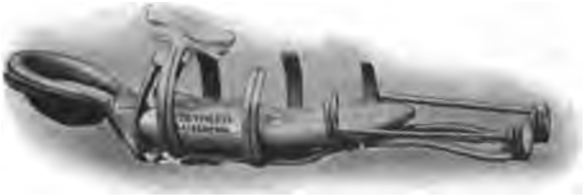

FIG. 32.

We carry out the recumbent treatment of rickets as follows: (1) The case is kept on a double Thomas' frame with a head-piece (Fig. 32); this relieves the spine and thorax of the weight of the head and shoulders, and allows untrammelled respiration; (2) if there is any tendency to knock-knee, "knock-knee bars" are added as shown in the figure; (3) if there is any coxa vara, extension is put on the limb; in the acute stage the bones are soft, and can be moulded without fracture; any existing deformity of long bones is thus straightened and fixed on a splint; (4) the recumbent position in the splint is continued until the bones are hard, usually for three months, the child being in the open air all day, and in the sun as much as possible. The usual anti-rachitic diet and treatment (*vide* Article on Rickets) are to be rigorously enforced.

Care must be taken that the bones of the upper limb are kept straight and that the child does not lie with them crossed over one another, for we have seen sharp curvature of the forearms produced by this habit. In the splint described the child cannot use the arms for supporting any part of the body weight.

Osteotomy.—In late cases where bone deformity is confirmed osteotomy of several of the long bones may be necessary. The great point is to restore the line of the axis of the bone and wait for growth to restore the æsthetic effects.

Osteotomy of long bones should be performed at the summit or apex of the deformity. In the rare instances where a wedge of bone must be removed we have for some years been in the habit of doing this in two stages : (1) The bone is divided with the chisel through three-fourths or four-fifths of its diameter; the skin wound is stitched and dressed and the patient sent back to bed ; (2) a fortnight later, when the wound is healed, the bone is snapped across, the deformity corrected, and the injury treated as a simple fracture. We now have none of the anxiety we used to experience when we operated in one stage and had to treat the deformity and a compound fracture simultaneously.

This is now our routine operation for coxa vara, bow-leg, genu varum, and deformities of long bones generally, where osteotomy with removal of a wedge of bone is required.

VI. SCOLIOSIS, DEFORMITIES OF THE SHOULDERS, AND TORTICOLLIS.

Scoliosis, Lateral Curvature, or Rotato-lateral Curvature of the Spine presents great difficulties in regard to accurate diagnosis and appropriate treatment.

Treatment must be continued for years, and is very trying to the patience and perseverance of subject and practitioner. Unfortunately there is a pessimistic spirit abroad concerning these cases, which are too often sent to an instrument maker to be fitted with some sort of a support, frequently made by rule of thumb, without proper consideration of the special features of each individual case. In other quarters too much has been expected of treatment by gymnastics.

The object of the present article is to show how the principles laid down in the introductory section apply to cases of scoliosis and to indicate how treatment by supporting apparatus may be combined with gymnastics to obtain results better than can be obtained by either method alone. The remote effects of scoliosis, distortion of the thorax with impairment of the function of heart and lungs, are so serious that it is the duty of the practitioner to attack every case he sees with a view to improving the deformity or at the very worst preventing its further aggravation. If an intelligent scheme of treatment based on sound principles is systematically carried out it is surprising how few the cases are which cannot be materially improved. Absolute cure can only be hoped for in the earliest and mildest types.

The initial causes may be as widely different as congenital irregularities of the vertebræ or ribs, torticollis, inequality of vision or of hearing on the two sides, bad habitual positions, polio-myelitis, or changes secondary to acute infective diseases, empyema, or chronic heart disease. Once the deformity is produced gravity and the contraction of muscles and ligaments on the concave side tend to make it worse and make it fixed; concurrently changes are taking place in bone, adapting its structure to the new conditions in accordance with Wolff's law.

Owing to the mechanical arrangements of the spinal column, lateral flexion is impossible without rotation and *vice versâ*. Therefore, in examining a case and in planning appropriate treatment, these factors must be constantly kept in mind, as well as the primary cause, whatever it may be. The three fundamental factors of deformity are present: (1) Contracture or adaptive shortening of the muscles and ligaments on the concave side of the deformity, including rotators; (2) over-stretching of muscles and ligaments on the convex side of the deformity; (3) changes in bone. Treatment, therefore, must aim at the achievement of three things: (1) Stretching the contracted structures on the concave side and correcting the deformity; (2) strengthening the weakened and overstretched muscles on the convex side; (3) prevention of gross bony deformity, and when this has already occurred, retention of the spine constantly in such a position that future growth will tend to correct and not to perpetuate the deformity.

It is impossible in a short article to discuss all the various methods of treatment advised; we shall give a brief outline of some of the methods we find most useful and of the principles which guide us in treatment: (1) The shortened muscles may be stretched by the patient or by the surgeon; if the patient can correct the deformity by a voluntary muscular effort, then by exercises the muscles may be strengthened so as to maintain the spine in the corrected position; (2) in a second class of case the antagonising group of muscles are so over-stretched that the patient cannot voluntarily correct the deformity; if the spine be straightened and retained in the corrected position the over-stretched muscles shorten, and recover the power of voluntary contraction, and thus the case may be converted into one which can be treated by gymnastics; (3) in a third case, where rotation deformity is pronounced, it is possible to apply plaster to support the chest and spine in such a way that every respiration is a corrective exercise; thus the two methods are combined in a paradoxical manner. During this period weak muscles are being rested, and of course bone will always alter its shape and structure according to the strain which is put upon it.

The Method of Examining a Patient should be systematic. It is much best to have the patient stripped; when this is not practicable one light garment should be worn, the back being stripped down to the top of the buttocks to show the top of the natal cleft and the crest of the ilium. Curves are called "left" or "right," according as they are convex to the left or to the right of a line drawn from the seventh cervical spine to the natal cleft.

The patient is left standing quietly in front of the surgeon; in about a minute the muscles relax, and the true nature of the deformity may then be seen.

(1) Note the poise of the head, and whether the shoulders are level.

(2) Note if the pelvis or the main mass of the shoulders or trunk is deflected to one side or other of a vertical line rising from a point midway between the feet; note the curves of the spine.

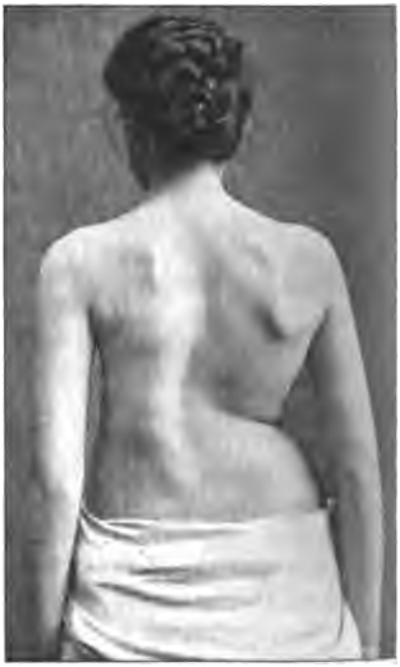

FIG. 33.—Shows a pronounced "loin angle."

(3) Note the contour of the loins above the crest of the ilium; a difference in the acuteness of the "loin angle" or a fold in the skin in one loin is one of the earliest signs of lateral curvature (*vide* Fig. 33).

(4) Look at the patient from the front and note any asymmetry of the thorax, but do not touch the patient. A child always pulls himself together if touched, and the relaxed position is what we wish to study.

(5) Examine for rotation of the spine by making the patient bend forward and look along the spine as if along a rifle barrel. Slight dorsal rotation produces pronounced prominence of the angles of the ribs on the side of the curve. A very slight difference in the prominence of the muscles on one side of the lumbar spine is evidence of considerable rotation deformity; the prominence is produced by the transverse processes under stretched muscles. Rotation in one part of the spine is nearly always accompanied by compensatory rotation in another.

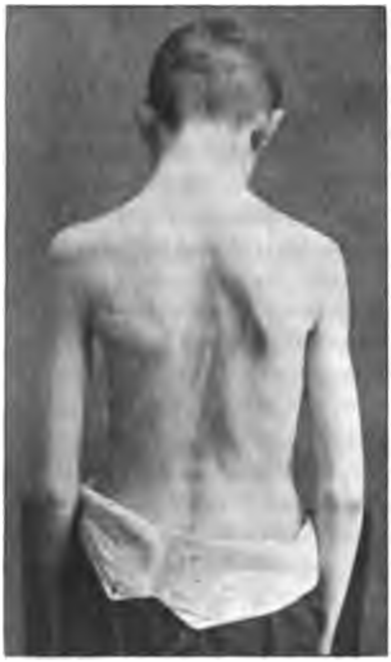

FIG. 34.

(6) Let the patient stand erect and note if the summits of iliac crests are on the same level; a forefinger may be placed on the highest point of the crest; this is the first time the child is touched. Any inequality is evidence of "pelvic tilting" to one side.

For methods of making exact measurements and records larger works on scoliosis must be consulted. For ordinary purposes good photographs suffice.

(7) Let the patient lie face downwards on a flat couch and note first of all if the curve is less pronounced than when the patient stands. This is very important, for purely postural curves almost disappear in the prone position, and in structural curves the mobile or postural part of the curve tends to disappear in this position.

(8) With the patient lying down, measure the lower limbs from the anterior superior spine to the internal malleolus and note if any difference in the length of the limbs would account for the production of the curve. To test this point let the patient stand with a book or board under the short limb and note if this alteration in the balance has any effect in correcting the curve. Ordering an addition of ½ or ¾ inch to one heel often deflects the body weight in such a way as to correct slight lateral curvatures. In employing this device it is necessary to see the patient at

regular intervals lest the correction be carried too far and a curve in the opposite direction be produced.

(9) Let an assistant lift the child a little by the chin and occiput so as to take the weight of the head and shoulders off the spine and see if the back becomes straighter; if it does the curve is not fixed and may readily be improved.

(10) Finally, stand close to the child and look down along the back and note if the shoulders are square with the pelvis; if one shoulder is a little behind the other there must be rotation in some part of the spine. If this has not been already detected, examine again for rotation.

A systematic examination of this sort not only determines the locality, direction and degree of mobility of the curve, but gives an indication of the line of treatment to be adopted. The next stage of the examination is to make the patient perform some simple exercises and note if they produce a visible improvement of the curve. This applies specially to postural curves where it is still possible for the patient voluntarily to correct the deformity. Those exercises which produce the most visible improvement are selected and the patient is taught to practise them. An expert properly trained gymnast ought to be employed, for unless corrective exercises are properly performed they lose much of their value. The selection of exercises should not be left entirely to the gymnastic instructor. On the other hand, a good gymnastic instructor will note if any exercise ordered does not appear beneficial and will at once report the fact to the practitioner.

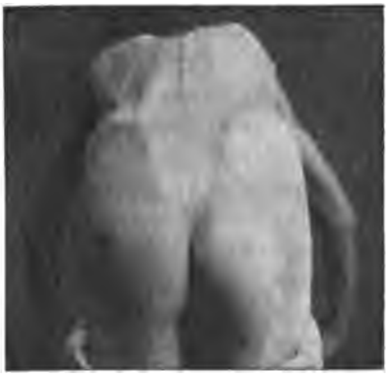

FIG. 35.—Same case as Fig. 34. Showing rotation in dorsal region.

Many cases of spinal curvature are too far advanced to derive as much benefit as one would like from gymnastics alone, or even from passive correction movements performed by the instructor. These are cases (1) where the muscles on the convexity are too long effectively to oppose the action of contracted muscles, and (2) when, in addition, changes in bone are so advanced that the spinal column must fall into a faulty position unless it is held straight.

In these cases preliminary treatment by manipulative correction of the deformity, followed by a long period of restraint in a plaster jacket, stretches and weakens short muscles which are too powerful, allows over-stretched muscles to shorten and recover power, so that the muscular balance of the back is improved, and finally gives time for the bones to adapt themselves in some degree to the corrected position. In this way a case not suitable for gymnastic treatment can be converted into one which is capable of receiving benefit from gymnastics. A point not sufficiently appreciated by many gymnasts, to whom cases of scoliosis are referred for treatment, is that the increase of mobility which is produced by gymnastic exercise makes the deformity worse, unless the patient can and does voluntarily hold the spine straight between the periods of exercise. Now the patient cannot do this in any but milder cases, for the short muscles, stretched like a bowstring across the concavity of the curve, have a tremendous mechanical advantage over their opponents which are stretched round the convexity. We have seen many cases in which the back has undoubtedly become stronger under gymnastic treatment, but when the patient stands rigidly to attention the unbalanced action of the muscles makes the curve worse than it is in the relaxed position and still worse, of course, than it is when the patient lies prone. Gymnasts are very apt to forget that the first point in the treatment is to restore the balance of the back, and to do this they must *weaken the short powerful muscles.* When the balance between the muscles of the two sides has been in some measure restored and at the same time the deformity has been partly corrected, then, gymnastics may be employed with real advantage to strengthen the muscles and further correct the deformity.

There are many ways of employing plaster in the treatment of scoliosis; we prefer to swathe the patient in a thin layer of non-absorbent cotton-wool applied over an undervest, and then apply plaster bandages. The use of plaster jackets for scoliosis can only be justified in cases where by manipulation the deformity can be distinctly improved, but the patient cannot maintain the improvement by muscular effort. The only use of a plaster jacket is to give weak muscles time to recover power; and by keeping the spine for a time in a corrected position to allow some degree of adaptive change to occur in bone. The patient may be suspended or partially suspended by the head and shoulders, but we have found it better to have the patient in a horizontal position on an Adams' frame. A plaster jacket may be applied (1) primarily to correct lateral flexion and to maintain extension, or (2) primarily to correct torsion by the method described by Hoke and Andrewes, of Atlanta.

(1) The patient is placed horizontally on the Adams' frame, the greatest possible correction of the curve is made without using any force, then the plaster bandages are applied, care being taken first to get a firm grip of the pelvis between the crest of the ilium and the great trochanter. The plaster jacket is carried right up to the head and is moulded well in under the occiput and the mastoid processes, and is afterwards trimmed, cutting away portions not required. When the patient stands the whole case rests on the hips, and the head rests on the collar so that the spine does not collapse.

Experience has shown that in certain cases a great degree of improvement both in the straightness of the spine and in the balance of the muscles is obtained by this means, but it does not have a great effect in correcting rotation deformity. Now, if any part of the rotation remain uncorrected, the corresponding lateral flexion remains uncorrected, and it is impossible to correct rotation effectively by mere extension of the spine.

(2) The method of Hoke and Andrewes attacks the rotation deformity primarily and has proved itself a powerful means of correcting deformities to an extent which we never attained six years ago before we began using it.

These surgeons noticed that in a patient with marked rotation deformity of the thorax the respiratory excursion of the thorax was mainly in the long oblique diameter of the deformed thorax, and that every respiratory effort tended to increase the rotation. Further, the flat areas of the thorax move very little in respiration. Now, if the surgeon place his hands on the prominent part of the chest and exerts very moderate pressure, he checks the excursion of the thorax in its long diameter, and immediately there is an increased excursion in the short diameter and the flat sunken parts of the chest wall move more than before.

The plaster case is applied as already described, but great windows are cut out of it over the flattened portions of the chest wall, leaving them free to expand, while firm pressure is maintained on the prominent portions. We thus have the paradox that by fixing the chest in plaster we are giving it a rotation exercise which tends to correct the rotation deformity. The exercise is continued rhythmically sixteen to twenty times a minute day and night, for every respiratory movement is a corrective exercise. The case is changed every three or four weeks and a new one fitted. Of this method we can only say that we have not yet sufficient experience to define the limits of its usefulness with any accuracy. We have employed it tentatively in some cases in which we regarded the deformity as too fixed and too rigid to yield to any form of treatment, and have had results whose excellence surprised us. This method of treatment is worthy of wider use and of closer study than has yet been given to it.

Whatever method of treatment in plaster is adopted, exercise must not be neglected. The patient must be out in the open air and in the sun as much as possible, must be encouraged to walk and run about short of producing fatigue, and should have regular systematic gymnastic exercises for the arms and legs. A successive series of plaster jackets are applied every month or six weeks as long as progress is being made.

The next stage is important. When the plaster jacket is removed it must always be done with the patient lying down, so that the action of gravity may not for one instant assert itself to reproduce the deformity or again stretch the muscles which are recovering. The state of the muscles is examined with the child lying on a flat couch, by getting her to perform some simple exercises, care being taken to avoid any exercise which would tend to increase the deformity. For some weeks after removal of the plaster systematic exercises should be performed in the recumbent position and the muscles of the back should be massaged.

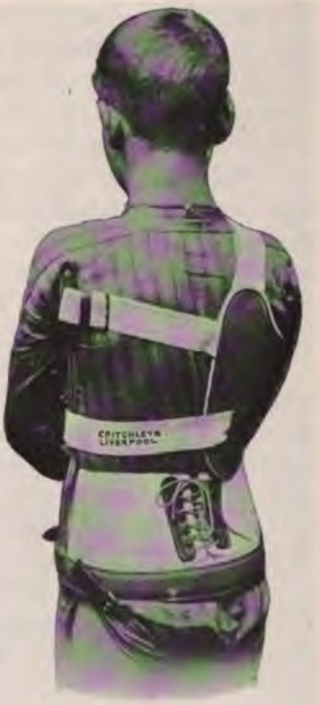

FIG. 36.

Now the child is fitted with a light support, such as that in Fig. 36. The object of this is simply to support the back and prevent gravity from causing the spine to collapse.

At stated intervals two or three times daily the support is removed with the child lying down, and in this position exercises are done under proper supervision. The child is never allowed to stand or sit up without the support till the muscles are strong enough to maintain the back in the corrected position. After this, gymnastic exercises in the erect position are commenced. At first these must be for only a few minutes at a time, but the period of exercise is gradually increased, while fewer exercises are done in the prone position. Between the periods of exercise the support must be worn, for the muscles are not strong enough to maintain the correction all the time. The periods of exercise commence at about an hour a day, divided into three periods of twenty minutes each. As the back gets stronger the periods of exercise are increased. Even when the surgeon feels that the patient may go nearly all day without wearing the support, it must still be worn at night, for in the relaxed position during sleep the spine will tend to fall into the deformed position, and this must never be permitted.

Finally, a stage is reached in which supports may be discarded altogether, and gymnastics form the only form of treatment. It is well to have the support ready in the early stages of this treatment, for fatigue and pain in the back are an indication that too much strain has been put on the muscles, and a short rest in the support is required to let them recover.

It follows, therefore, that cases of scoliosis may be divided into:

(1) Cases which may be treated by gymnastics alone. These are habit scoliosis and postural scoliosis, where there is no definite structural change in the bones; cases in which the patient can voluntarily correct the deformity and can by an effort of will maintain the correction.

(2) Cases which must have some sort of light support, for though the patient can correct the deformity in a great measure by a voluntary muscular effort, the effort is too great to be made continuously, and some support is required during the intervals of relaxation. These cases include late postural curves and early transitional curves in which structural change is beginning to occur.

(3) Cases in which deformity must first be corrected by manipulation and the back must be supported by plaster to allow adaptive changes to take place before they can be treated by the methods previously described. These include structural curves, in which actual structural change has taken place in the shape of bones. The patient may not be able to improve the back by a muscular effort, but if the surgeon can straighten the back at all by lifting the child by the head, some improvement can certainly be made in the condition of the back.

The difficulty arises in cases in which the curve is fixed, in which no exercise seems to improve the back, and lifting the patient by the head does not extend the spine at all. At one time we regarded these cases as fixed and incurable, and contented ourselves with seeing that they were not allowed to get worse. Now we know that some but not all of them will perceptibly improve if submitted to forcible correction and the application of plaster jackets with windows cut out of them.

Finally, there still remain cases in which we cannot effect much improvement and must content ourselves with watching the case and preventing it from getting worse. In cases of paralytic scoliosis many muscles apparently paralysed will be found to be over-stretched and these will recover, but some groups of muscles will generally remain permanently weak or paralysed in spite of treatment. In all such cases some sort of spinal support, generally of a wedge type, supporting the overhanging spine and ribs, must always be worn, for the best we can do is to correct the deformity to some extent; we cannot cure the paralysed muscles.

Gymnastics.—(1) All gymnastics must be directed with two objects in view, (*a*) correction of the lateral curve, (*b*) correction of rotation; (2) all gymnastic exercises produce two direct effects, (*a*) they stretch tense ligaments and muscles and therefore make the spinal column more flexible and mobile; (*b*) they strengthen the muscles exercised.

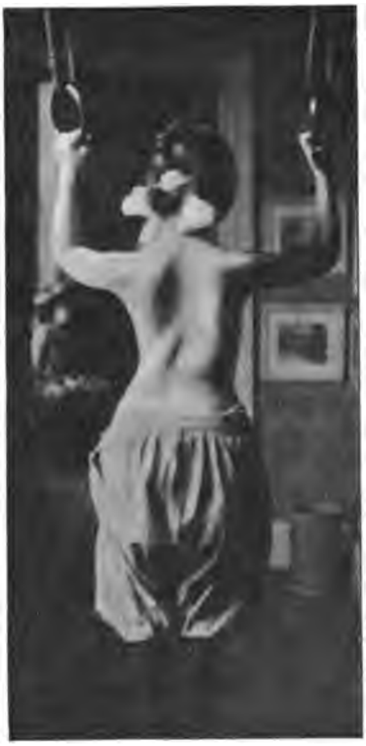

FIG. 37.—The patient showing left lumbar and right dorsal scoliosis.

It is true some exercises produce the one effect more than the other, but both effects are produced in varying degree by all exercises.

If a case of scoliosis is to be attacked by means of gymnastics the exercises first practised must be directed to stretching short structures to loosen up the spinal column and make it more flexible. As we have stated already, this increased flexibility of the spine involves a danger of the deformity becoming worse in positions of relaxation and fatigue; therefore, in every case where the patient is not able to maintain the correction obtained by exercise throughout the interval between the exercises, some form of spinal support should be worn. The support should be constructed so as to maintain the fullest possible degree of correction and take as much strain as possible off the weaker group of muscles, so that they may not further over-stretched but may rest between the gymnastic lessons.

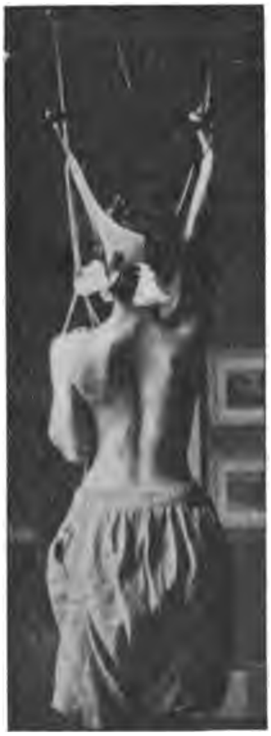

FIG. 38.—Shows that the curve is flexible, not fixed, for it is almost obliterated when the patient is suspended by the head and hands.

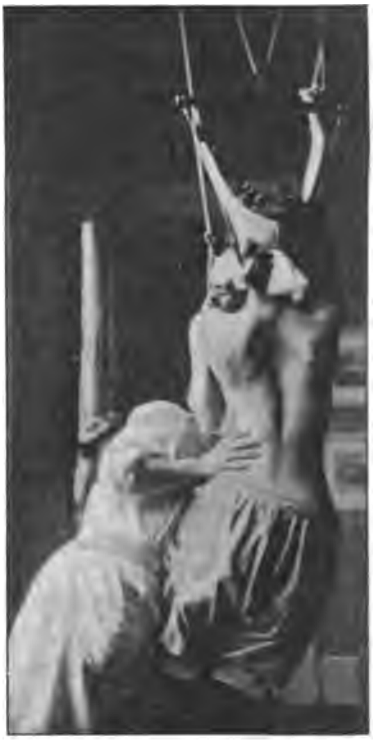

FIG. 39.—Passive stretching of the lumbar curve in the preceding position. The instructress is pressing the loin to the right and drawing the patient's knees to the left.

Exercises must be carefully selected: (1) In mild postural cases, all that is required is a systematic setting-up drill such as army recruits receive; (2) in cases a little more pronounced care must be taken to exercise the weaker group of muscles, and the muscles already too strong must not be exercised till the muscular balance of the back is restored; hence such a case begins by practising asymmetrical exercises; (3) weak cases which have to wear supports, or have been through a course of treatment in plaster of paris, first have a course of exercise lying down. As they get stronger they are promoted to Klapp's creeping exercises; then they perform one or two exercises in a sitting position, and thus by gradual stages the back is trained till really strong gymnastic movements can be practised.

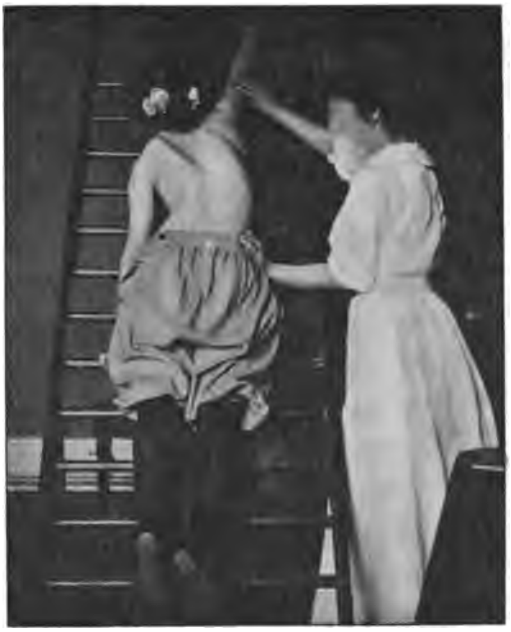

FIG. 40.—On the ladder. Grasping the highest possible rung with the right hand and the lowest with left, the patient takes forced inspirations. The instructress's hand on the pelvis prevents the pelvis from being swung to the right by the muscular effort.

Remedial gymnastic movements should be taught by an expert gymnast, for unless the patient learns to perform them properly, with the proper voluntary emphasis or effort in the action of certain muscles, these exercises lose much of their value.

So-called free gymnastic movements as taught in schools in this country are too often slovenly and purposeless and lack the precision and finish demanded by Swedish and Danish teachers.

It is desirable, therefore, that the gymnastic instructor selected should have had a proper training on Swedish lines; such gymnasts can now be found in most parts of the country.

The selection of exercises depends on the individual case to be treated. For simple mild postural curves the Swedish movements form an excellent basis. The British Government has now adopted these for the physical training of recruits.[1]

In treating scoliosis every movement must be taken as a *breathing exercise*, for the lift and twist of the ribs during inspiration has a powerful effect on the ribs. Breathing must therefore come in proper relation to the movements of the trunk and limbs to produce the maximum effect.

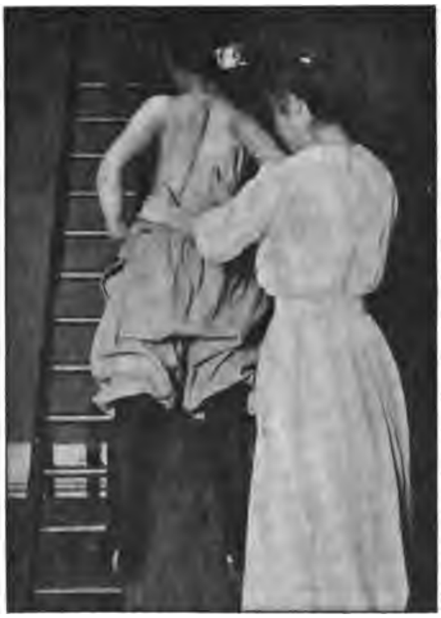

FIG. 41.—A rotation exercise. The patient raises her head and shoulders from the ladder, at the same time turning them to the left, while the instructress presses on the prominent angles of the ribs on the right side.

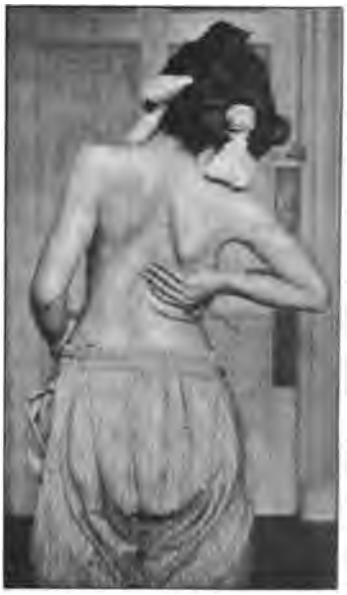

FIG. 42.—A self-correction exercise in which the patient bends to the right while pressing in the prominent ribs on the right side.

Exercises fall into three groups:

(1) Simple Swedish drill movements, consisting of flexions and extensions of the trunk and limbs, bending the trunk sideways and rotations of the trunk. These are too numerous to be dealt with in this article. If the surgeon sees his patient along with

the gymnastic instructor he will soon select those movements which produce most effect in visibly correcting the deformities of the spine, and should order these to be practised. Such treatment is only applicable to the very mildest postural deformities, in which the patient is able to correct his own deformity by a voluntary muscular effort.

(2) In slightly more severe cases the patient can only correct his own deformity partially. Assistance in the process of stretching shortened structures may be secured, either by apparatus which gives the patient a point of purchase, or by the instructor actively assisting the patient in performing the movement, or by both combined.

(3) Resistance exercises are used when weak muscles are beginning to recover power. In these the instructor resists the patient's movements so as to make the exercise more difficult and to compel the muscles to do more work. By graduating the amount of resistance the instructor can make the exercise more and more difficult.

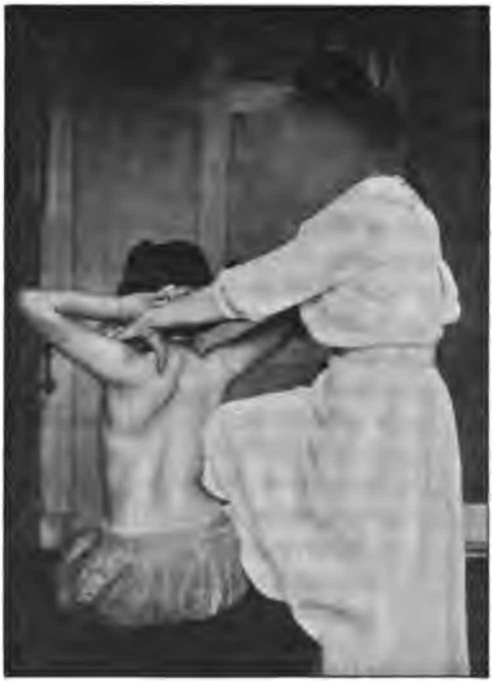

FIG. 43.—An assisted or resisted rotation exercise, in which the instructress is pressing her knee against the prominent ribs on the right side while helping the patient to turn the shoulders to the left or resist the movement.

. The illustrations (Figs. 37 to 43), all of the same patient, illustrate a typical series of movements and exercises.

Congenital Elevation of the Shoulder (Sprengel's Deformity) is a condition of which the etiology has been much discussed. The chief factor of the deformity is that the scapula is placed too high up towards the neck, as it is in the embryo. For some reason or other it has not descended to its normal position. The levator anguli scapulæ muscle in particular is short, and fibrous or even fibro-cartilaginous changes may occur in it and in the rhomboid muscles, constituting abnormal attachments of the scapula. Still more important is the fact that the young soft scapula is placed over the upper conical portion of the thorax and necessarily adapts itself to the shape of this part. The upper part of the scapula is therefore curled forward and prevents the bone from sliding about on the back of the thorax in the normal manner. In consequence of this limitation of the movement of the scapula the main functional disability is impairment of the power of abducting and elevating the arm.

Treatment.—We have adopted all sorts of means of pressure to make the scapula descend, we have divided all short muscles round the scapula without conspicuous success, and now usually are content to practise passive and active movements of the arm and shoulder to stretch shortened structures and increase the range of mobility.

Operation.—As pointed out by Goldthwaite, curling forward of the superior angle may be a mechanical obstruction to rotatory and sliding movements of the scapula. When such is the case the offending portion of the superior angle should be removed. The incision is parallel to the upper border of the spine. The insertion of the trapezius is divided for about 2 inches. The supraspinatus with the periosteum and the attachment of the levator anguli is pushed aside with a raspatory and as much of the bone as necessary removed.

After the wound is healed, exercises and movements must be practised to increase the range of movement of the scapula.

Round Shoulders may be clinically of two types, flexible or fixed. In the former the patient can by an effort straighten his back and square his shoulders. Such cases can be cured by attention to general health, improvement of general tone, and by setting-up drill. It should be remembered that round shoulders must not be regarded as a simple isolated deformity; they are part of a general disturbance of the balance of the body, and frequently a part of the deformity in cases of knock-knee and flat-foot. They can only be treated successfully by treating the patient as a whole and correcting all errors of carriage and gait. Drooping of the shoulders is a position of weakness owing to want of power in the muscles of the shoulders to keep the scapula up and braced backward. In the case of children with adenoids the deformity is also associated with defective expansion of the chest. Improper clothing is a factor in the production of this condition, for children's clothing is usually attached to a body garment which hangs on the shoulders.

Care should be taken that the weight hangs on the inner end of the clavicle near the root of the neck, and not on the tip of the acromion process, for no weak child can carry 5 lb. all day hanging from the tips of the shoulders without letting them droop. The practice of fastening elastic stocking suspenders to the same garment and making them tight enough to keep the stockings from wrinkling, of course adds to the weight on the shoulders.

In fixed or resistant round shoulder the whole conformation of the thorax as well as muscles and ligaments have undergone adaptive changes. The patient cannot straighten the dorsal spine and square the shoulders by a voluntary effort. Treatment must therefore be more active; exercises must be performed with a firm pad between the shoulders, across which the back is stretched. The gymnastic instructor must perform passive movements to stretch the back and shoulders over the pad.

All exercises must be done in time to full inspiration, for the whole front of the chest is flattened and depressed. The type of exercises required are those directed to bracing the shoulders backward, undoing the stoop shoulder, and lifting the clavicles and sternum by full inspiration.

Cases requiring actual forcible stretching and a period of support in plaster or other jackets are rare.

Torticollis or Wryneck.—The spasmodic variety of wryneck is due to nervous disturbances, and is dealt with in the section on Surgery of Nerves. There remain the fixed and spastic forms of torticollis.

Fixed torticollis may be an incident in Pott's disease, in scoliosis, or may be associated with irregularities in the conformation and ossification of the vertebræ. Such cases must be dealt with on general principles in the course of the treatment of those conditions which give rise to them.

Spastic or muscular torticollis is a very common condition associated with shortening of muscles and fasciæ, especially of the sterno-mastoid muscle and its sheath.

Practical experience has shown that the chief difficulty in treatment lies in the shortened sterno-mastoid and the cervical fasciæ near it.

Treatment.—In young infants and in some early cases the deformity can be over-corrected without any great effort. All that is required is to put the patient into a suitable collar which will maintain the over-corrected position. When the shortened muscles are fully stretched and the lengthened muscles have shortened, the neck is massaged and flexion and rotation exercises for the neck are practised. The collar, however, should still be worn at night. The test of recovery is the return of the power fully to over-correct the deformity by a voluntary muscular effort.

Operation.—Many cases are too stiff to yield to such passive stretching. The resistance is not so much in the sterno-mastoid muscle as in the cervical fasciæ which forms its sheath. Hence subcutaneous division of the muscle is rarely satisfactory. We always expose the lower end of the sterno-mastoid and divide the muscle completely within ½ or 1 inch of its origin. Every tight band of fascia in its sheath, especially in the posterior layer, is then divided until the head can be put into the over-corrected position without resistance. To do this safely the muscle must be completely divided to expose the carotid sheath.

With the fingers we draw the skin of the neck down over the clavicle and make a transverse incision on to the bone; when the skin is released the wound is over the lower part of the sterno-mastoid.

To avoid an ugly scar, the superficial fascia and especially the platysma myoides should be carefully sutured before closing the skin.

Division of the belly of the muscle should be avoided, for we have seen the muscle retract and form an unsightly lump after this operation.

The after-treatment consists in the use of a collar, massage and exercise.

VII. DEFORMITIES DUE TO SPINAL AND NERVE PARALYSIS.

In the deformities we have already discussed there have been two main factors in treatment: (1) Reduction of existing deformity and (2) restoration of the normal balance of power between contracted powerful muscles and over-stretched weak muscles.

In dealing with spinal paralysis of the type of polio-myelitis acuta we have an additional difficulty to meet from the fact that the motor cells in the spinal cord are impaired or destroyed. Fortunately a great part of the acute paralysis, which appears at first, generally passes off, leaving only certain muscles or groups of muscles paralysed. It is not sufficiently appreciated that much of this apparently complete paralysis is only partial, and is amenable to suitable treatment short of operation.

As will be shown in this article, paralysis of a muscle depends not merely on the state of the spinal motor cells, but also on the condition of the nerve, and finally on that of the muscle itself.

Many cases of paralysis are regarded as hopeless because treatment by massage and electricity has failed to produce material improvement. Experience has shown that a paralysed muscle, which has been over-stretched, either by contraction of relatively powerful antagonists or by gravity, is incapable of contraction, even if its motor cell in the spinal cord has recovered. As a rule, massage and electricity are of no avail in these cases unless the muscle is relieved of tension, that is to say, the limb must be fixed in a position in which the muscle is relaxed; the latter then shortens and at the same time recovers its power of voluntary contraction and comes under the control of its motor cell in the cord. Mere continuous relaxation of the weak muscle suffices for this, but it may take months to obtain a good result; massage is of great use in hastening recovery, but we do not think that electricity, either galvanic or faradic, produces much effect. It must be remembered that a muscle which is thoroughly over-stretched and atrophied from disuse may not react at all to any electrical stimulus. If, however, the slightest flicker of voluntary contraction can be detected recovery can be predicted with confidence; while many cases in which the muscles show absolutely no sign of contractile power frequently surprise the surgeon by recovering under a prolonged course of absolute rest.

The next point we have to consider is how paralysis and its consequent deformity may be reduced to a minimum by treatment during the acute stage.

During the stage of acute polio-myelitis motor cells over a considerable area of the spinal cord are put out of action and the muscles they supply are paralysed. The limbs lie flaccid, and the position they assume depends chiefly on gravity, pressure of bedclothes and other extraneous forces. In the lower limb the thighs are usually rotated inwards and slightly flexed. The knees are flexed, because this is an easy position. The foot is pointed and lying on its inner side, and this position of equino-varus is maintained by the bedclothes. In the upper limb the wrist and fingers are very often in a flexed position.

Now, if this position be maintained for some time the flexor groups undergo some adaptive shortening. The time comes when the acute condition in the spinal cord begins to pass off; those motor cells in the cord which have not been entirely destroyed but only temporarily affected begin to exercise their function. Now the flexor muscles, which have perhaps undergone some degree of adaptive shortening, soon respond to motor impulses sent by the recovering motor cells, while the extensor groups which have for some time been kept in an over-stretched position are in a state of mechanical disadvantage; they are too long, and their opponents are slightly shortened; therefore the extensor groups cannot respond to the first motor impulses sent down to them by their recovering motor cells, and they remain to all appearance paralysed. *It is to be noted that the fault is no longer in the motor cell but in the muscle.*

Clinical experience shows that some improvement takes place under treatment by massage and electricity, but an over-stretched muscle placed at mechanical disadvantage does not and cannot recover under such treatment alone. If, however, the muscle be kept relaxed long enough to let it undergo adaptive shortening to its normal length, and be so placed once more in its normal mechanical relationships, it recovers independently of treatment by massage or electricity.

(1) No muscle is to be regarded as hopelessly paralysed, no matter what period of time has elapsed since the onset of the paralysis, unless it fails to act after a sufficient period of rest in the appropriate posture to allow it to shorten.

(2) Every muscle in which the slightest flicker of voluntary movement can be detected will recover if put under favourable mechanical conditions.

No attempt will be made in this article to discuss the various ingenious theories put forward to explain why extensor muscles are generally more profoundly paralysed than flexor muscles. Such theories have ranged from the fact that flexor groups are naturally stronger than extensor groups to the theory that the spinal centres for post-axial muscles are so placid in the spinal cord that they are more affected by toxins than pre-axial centres.

We content ourselves with the clinical fact that the doctrine of the over-stretched muscle goes a long way towards explaining this phenomenon, and that paralysis from over-stretching of muscles can in the first instance be prevented by taking care during the stage of complete paralysis to fix the limb in such a position that no muscle is unduly stretched; and in the second place paralysis from over-stretching can be cured by giving the muscle proper relief and rest.

This principle will be repeatedly referred to and illustrated in dealing with the several paralytic deformities which we now proceed to discuss.

PARALYTIC DEFORMITIES OF THE UPPER LIMB. **Dropped-wrist.**—The various forms of dropped-wrist furnish very simple illustrations of the practical application of the principles propounded in the previous section. We shall consider this condition in progressive stages, first, a case of apparent paralysis due to over-stretching alone; second, dropped-wrist in drunkard's palsy; third, dropped-wrist in lead palsy; and fourth, dropped-wrist in poliomyelitis.

(1) "A surgical friend having stitched some divided flexor tendons in the wrist, kept the hand for a fortnight in an acutely flexed position. As the patient two months later could not voluntarily extend the hand he was sent to us. The wrist at that time could quite easily be moved passively in all directions, but it required over a fortnight of hyper-extension on a splint to restore the power of voluntary contraction to the extensor muscles." This is a case of apparent paralysis of two months' duration due to over-stretching alone; there were no contractures or adhesions on the flexor side to prevent extension.

(2) In drunkard's palsy some cases of dropped-wrist are due to pressure on the musculo-spiral nerve, others to sleeping with the hand acutely flexed with the extensor muscles over-stretched.

If promptly dealt with these cases generally recover in a few days, but some cases which have been neglected at first remain paralysed for an indefinite period until they are put into the hyper-extended position on a splint (Fig. 44) for a sufficient period to allow the muscles to shorten and recover their contractile power. Recovery under this treatment shows that although pressure on the nerve may have caused the dropped-wrist, its persistence is due to consequent over-stretching of extensor muscles.

(3) In dropped-wrist due to lead poisoning the primary mischief may be situated a stage higher up in the motor apparatus. In some cases there is a neuritis, in others the motor cell in the anterior horn of the grey matter of the cord is poisoned. There can be no doubt that this poisoning of motor cells and nerves is general, for symptoms of paralysis may appear in the lower limbs, or in the muscles of the trunk, as well as in the upper limbs. The localised forms described in text-books, namely, paralysis of the extensors of the wrist or the flexors of the elbow and deltoid, or the peroneal type involving the peronei and extensors of the toes, are all explicable on the hypothesis that the muscles involved are over-stretched. In our experience they are practically all curable by prolonged splinting in the position of complete relaxation of the paralysed muscle, even although the paralysis has existed for several years. Our belief is that lead rarely produces absolute destruction of motor cells. The residual paralyses which persist are almost entirely due to over-stretching of muscles; they are therefore preventable and generally curable. We have had to keep a case of dropped-wrist on a splint for months before power returned to the extensors.

(4) Dropped-wrist after polio-myelitis anterior acuta differs from dropped-wrist due to lead poisoning only in the fact that the toxin is more liable to cause complete destruction of the spinal motor cell. Polio-myelitis anterior acuta may cause complete paralysis of all muscles of one or more limbs, or paralysis of only certain groups or of individual muscles. Some cases recover so far that all that can be detected is slight weakness and atrophy of certain muscles, and we know there are transient cases which recover completely. Much of the residual paralysis which persists is due to over-stretching of muscles and not to permanent destruction of nerve-cells. It is possible for such cases to recover, and it is a reproach that they should have been allowed to occur.

Prognosis in Paralytic Dropped-wrist.—The surgeon presses his fingers lightly against the dorsum of the patient's hand in the flexed position and asks him to extend his fingers. If there be the slightest extensor movement the extensor muscles will certainly recover.

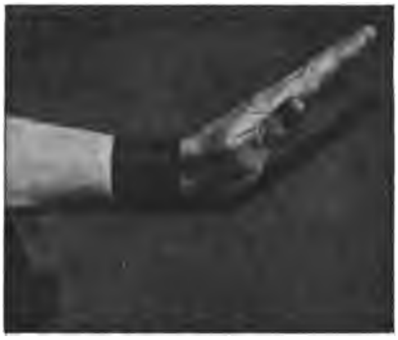

FIG. 44.—Showing the sign of recovery of extensor muscles, after treatment on the wrist splint.

Treatment. — The patient's hand and wrist are placed in the dorsi-flexed position on the wrist splint shown in Fig. 44. The hand piece of the splint extends up to the tips of the fingers. The extensor muscles are daily massaged to improve their nutrition. The splint is firmly fixed at the wrist, but no tight bandages are anywhere allowed to compress muscles or interfere with the circulation. The splint must be worn day and night without intermission. When removed at rare intervals to clean the hand, the surgeon must see that the wrist is not flexed even for an instant, as this would again stretch the muscles which we are endeavouring to shorten.

The Sign of Recovery is that the patient can voluntarily extend the wrist and fingers away from the splint (Fig. 44). When this occurs the hand piece is shortened to the level of the knuckles to give the fingers free play (Fig. 45), but at night a flat metal splint extending to the tips of the fingers is added to extend the fingers during sleep. Later, even the short splint may be left off during the day, but a splint must be worn at night until the restoration of the balance of power between extensors and flexors is so perfect that no relapse need be feared. Of course, the slightest sign of relapse is an indication that the splint has been left off too soon.

Paralysis affecting the Elbow and Shoulder.—Paralysis of the deltoid, supra- and infra-spinatus, biceps and supinators, corresponds to the upper arm type of Erb. In dealing with the elbow the chief object of treatment is to enable the patient to get his hand to his mouth to feed himself, fasten his collar and so forth.

Flail Elbow.—In this condition the main trouble is that the biceps and brachialis anticus are weak and the patient cannot flex the elbow. If the muscles of the hand have escaped, the patient has a useful hand at the end of a useless limb. Here, during the acute stage of paralysis, the limb has probably been left in extension, and after recovery gravity has kept it in extension, so that the biceps and brachialis anticus have never been free from strain.

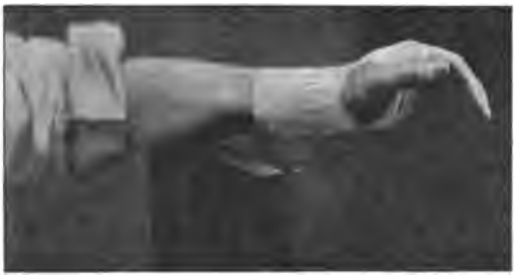

FIG. 45.—Shortened wrist splint, allowing freedom of movement of the fingers.

Treatment.—The only treatment which offers any chance of recovery of the biceps and brachialis anticus is that the muscles should be continuously kept relaxed and their circulation improved by massage.

The wrist should be slung in a halter, keeping the elbow at an angle considerably less than 90 degrees. If the supinators and extensors of the wrist are affected at all the wrist should also be fixed in dorsi-flexion as for dropped-wrist. If the slightest sign of recovery can be detected in the biceps a successful result may be confidently predicted, but the treatment must generally be continued without once extending the elbow even for an instant, for eighteen months or two years at least.

In one case in which we were consulted the practitioner was so satisfied with the recovery of movement obtained in a few months that he allowed his patient to leave off the sling. In a very short time he found the elbow as weak and flail-like as before. In this case the sling had been removed before the biceps was strong enough to resist the continuous action of gravity, and therefore the muscle soon became over-stretched.

Operative Treatment.—To meet the difficulty of over-stretching of the biceps by gravity and to fix the elbow in a useful position in cases where no recovery of the biceps seemed possible, the author eight years ago began to perform the following plastic operation.

A large diamond-shaped portion of skin is removed in front of the elbow-joint and sutures passed in a vertical direction, so that when the sutures are tied, the elbow is flexed and the skin is brought edge to edge, fixing the elbow in the flexed position.

In some cases recovery of the biceps has followed this operation, where such a result had previously been despaired of, showing that it is *continuous* relaxation of the paralysed and over-stretched muscle which alone gives it an opportunity of recovery.

In other cases, where considerable recovery of the biceps has been attained by treatment in a halter, the patient may wear a light apparatus at the elbow which prevents full extension. This prevents over-stretching of a biceps which is capable of moving the elbow through a certain range, but which relapses into a paralysed condition if stretched beyond this.

Paralysis of the Shoulder.—There is no object in attempting any treatment of the shoulder unless there is already a useful hand and elbow.

In some cases the chief trouble at the shoulder-joint is a laxness of the whole joint, with frequently recurring or persistent *paralytic anterior dislocation of the shoulder.* This condition may be treated often with great satisfaction to the patient and surgeon by shortening the antero-inferior part of the capsule.

Operation.—The capsule is exposed by an incision downwards from the coracoid process, as in the anterior operation for excision. The joint is not opened, but the capsule is exposed. The head is replaced in the glenoid, and then the capsule is caught with two pairs of toothed forceps and the slack part twisted into a roll till it is drawn tightly over the front of the joint. The roll of capsule is then transfixed with a series of sutures and securely fixed. The following after-treatment is essential: The arm is fixed in internal rotation, to let the subscapularis muscle have an opportunity to recover, and massage of the shoulder must be regularly carried out to improve the general tone of all the muscles controlling it.

Arthrodesis of the Shoulder-joint. — Arthrodesis in a slightly abducted position may be indicated in some cases where there is a useful hand and elbow and where there is no power in any of the muscles controlling the shoulder-joint, and finally where the muscles of the scapula are not paralysed. The object of the operation is to make the humerus move with the scapula. Hence, if the muscles controlling the scapula are paralysed, there is no object in performing this operation. If there is some power in any muscle controlling the shoulder-joint the patient can generally jerk or swing his hand into any position he wishes, and is, in our opinion, better off than with a stiff shoulder.

The shoulder-joint is exposed from in front by an incision commencing a little internal to the acromio-clavicular joint and running in the interval between the deltoid and pectoralis major muscles. The capsule is incised in the bicipital groove, and the coraco-acromial ligament is divided. The head of the humerus is then brought out of the wound.. The cartilage is removed from the head of the humerus and the glenoid cavity and the synovial membrane is removed.

The head is then wired or pinned to the glenoid in internal rotation, so that when the elbow is flexed the hand is brought up towards the mouth. The arm is then kept fixed for eight weeks.

Birth Palsies.—Birth palsies are usually obstetric in origin, and are due to stretching or tearing of the fifth cervical nerve during labour. The affection is sometimes bilateral. A similar condition from trauma in later life is not very uncommon.

The nerve path is not permanently blocked in the vast majority of cases, but these muscles paralysed by the original injury have been over-stretched, and will recover if given the necessary rest. Each of the elements of the deformity is therefore to be corrected and the arm fixed in the over-corrected position. Thus the thumb is abducted, the wrist fixed in hyper-extension and the elbow flexed, the wrist being slung up close to the neck.

In this position nothing is being done to relax the deltoid, therefore special attention must be paid to massaging it. Recovery is generally complete in three to four months, unless there is a permanent block or interruption of the nerve path. In the latter case Kennedy's operation for grafting the fifth root into the sixth and replanting the distal portion of the torn fibres into the nearest trunk is to be performed (*vide* Surgery of Nerves).

PARALYTIC DEFORMITIES OF THE LOWER LIMB.—In dealing with paralysis of the lower limb after polio-myelitis the same principles of treatment are applied as elsewhere, but the problem is modified by the fact that the limb is to be used for walking, and therefore security is of greater importance than mobility.

While we must admit that after some cases the paralysis is complete, yet in the lower limb, as in the upper, over-stretching of muscles plays a part in determining the groups of muscles which remain apparently paralysed.

Thus, in the acute stage of paralysis the foot lies in the equino-varus position from the effect of gravity and the weight of the bed-clothes; the extensors of the toes and ankle are thus stretched, hence "dropped-foot" is one of the commonest varieties of residual paralysis. The knees are flexed and turned inwards as in knock-knee; this stretches the quadriceps extensor, and hence this is a muscle which is paralysed much more often than the hamstrings.

There is flexion and internal rotation at the hip; hence there is often contracture or evidence of power in the ilio-psoas in cases where other muscles are paralysed.

For the same reason, adaptive shortening or contracture of tendons and fasciæ are apt to occur in the groin and tensor fasciæ femoris, keeping the thigh flexed and rotated inwards; in the hamstrings, preventing extension of the knee; sometimes in the tendo Achillis, producing pointed foot; much more often in the plantar fascia, producing pes cavus.

These may have to be corrected by forcible stretching, by subcutaneous tenotomy, by open incision, or by a combination of these.

For the tensor fasciæ femoris and iliac fascia an open incision 3 inches down from the anterior superior spine is the best.

The hamstrings are best divided by open incisions on either side of the popliteal space along the tendons, and not by a single transverse incision which gapes when the knee is straightened. The plantar fascia and tendo Achillis are dealt with as in treating club-foot.

Preventive Treatment.—Every patient the subject of paralysis affecting the lower limbs should be put on a straight back splint to prevent contracture of the hamstrings and stretching of the quadriceps. A foot-piece should keep the foot at right angles to the leg to prevent stretching of the extensors. If there is a tendency to flexion at the hip extension should be applied or the patient put in a hip splint. It may be necessary to divide the tensor fasciæ and rectus femoris to correct lordosis. If the muscles of the back are affected the case should at once be put in a spinal frame extending from the head to the heels. Daily massage, of course, helps in maintaining the condition of the affected muscles.

If the whole of one lower limb is paralysed beyond hope of recovery, even if it is several inches shorter than the other, the patient will be able to walk in a calliper splint with a high boot.

Paralysis of Muscles controlling the Hip-joint.—If any muscle controlling the hip (usually the ilio-psoas) has escaped, the patient can swing the thigh forward. In this case the patient can certainly wear a walking apparatus, such as a walking calliper splint, which carries the weight of the body from the tuber ischii even if the knee and ankle are very weak or quite useless.

Arthrodesis of the hip-joint is very rarely of real advantage to the patient except in a few cases where complete paralysis of the muscles controlling the hip-joint has led to such an insecure condition of the joint that an ankylosed joint will be preferable to any arrangement of apparatus to help the patient to walk.

Paralysis of Muscles controlling the Knee-joint.—If there is a total paralysis of both hamstrings and extensors so that the knee is quite flail, the best treatment is to let the patient wear an apparatus which will keep the knee straight when walking. It can be made with a joint to permit flexion when sitting.

Cases of paralytic genu recurvatum are treated in the same way.

At one time the author was in the habit of performing arthrodesis in these cases, but experience has shown that a stiff limb, with the femur and tibia ankylosed to form one long bone, which is specially liable to fracture, has more disadvantages than wearing an apparatus to secure the knee.

If the patient refuses to wear a suitable apparatus and elects to have a stiff knee, arthrodesis may be performed as follows: A U-shaped incision is made, commencing on the inner condyle and sweeping across the ligamentum patellæ to a corresponding point on the external condyle. The joint capsule is opened and the flap containing the patella turned up. Thin slices of the ends of the femur and tibia are shaved off with the saw so as to remove the cartilage and expose bony surfaces.

The ends of the bone are brought into close apposition and the limb put up in a straight position in plaster of paris or in a Thomas' knee splint with a straight back splint, a method which the writer prefers when he is allowed personally to superintend the after-treatment.

If the hamstrings are not paralysed, but the quadriceps extensor appears to be paralysed, the following procedure is indicated: Any contracture of the hamstrings and popliteal fascia must first be overcome and the limb straightened. If there is any idea of subsequently using the hamstrings to reinforce the quadriceps by tendon transplantation it is desirable to avoid dividing them in the first instance.

The quadriceps is often over-stretched but not permanently paralysed. In this case it will recover if kept relaxed and massaged.

For this purpose we put the limb in a Thomas' walking calliper, which is worn day and night. The patient is encouraged to walk about without crutches. Many cases which have previously been treated by massage and electricity and finally given up, recover if the over-stretched quadriceps is thus given an opportunity of shortening.

The degree of recovery in the quadriceps may not be sufficient to enable it to withstand the strain of bending the limb to a right angle when sitting. Such cases rapidly relapse, because the muscle is again stretched.

To meet this, two lines of treatment are possible: (1) The patient may wear a calliper with a joint which will only allow a limited degree of flexion, or a knee cage (Fig. 15), also provided with a stop to limit flexion; or (2) the quadriceps may be reinforced by transplanting the tendons of one or more of the hamstrings into it, preferably the biceps.

Operation.—The hamstring to be used is exposed by a long incision over the tendon. It is divided as low down as possible. A second incision is made crossing the upper margin of the patella in a line along which the grafted tendon will lie. A pair of forceps is pushed through the second wound, and the end of the divided hamstring is pulled through. The end of the hamstring tendon is then laced in and out through the aponeurosis of the quadriceps and the cut end finally buried under the aponeurosis on the front of the patella. It is secured by stitches both to the aponeurosis and to the patella. If the tendon is not long enough to reach the patella, it must be laced down to the firm aponeurosis on the front of the patella with several strands of strong suture. Unless secured in some way to the patella itself, the implanted tendon is apt to pull away and have a very weak attachment to the quadriceps.

After two or three weeks' rest in bed the patient is allowed to go about again, in a calliper splint with the knee straight.

Of course, hamstring tendons on both sides of the limb, *e.g.*, semi-tendinosus, and the biceps may be grafted at one operation.

Paralytic Deformities of the Foot and Ankle.—The first object of treatment is to secure for the patient a solid base of support so that the body weight may be carried fairly and squarely on the sole of the foot, and the second point is to avoid as far as possible unnecessary sacrifice of the natural spring of the foot.

The first of these is obtained by fixing and securing flail joints by arthrodesis, the second by refraining from producing ankylosis of joints where sufficient muscular power can be obtained to make the joint secure.

Some of our best results have been obtained in cases where complete ankylosis of the ankle has been attempted, but the operation has failed in so far that a short fibrous ankylosis instead of a bony ankylosis has been produced. Subsequently there has been in some cases sufficient recovery in the previously paralysed muscles for them to control the joint in its limited range of movement, while they would again inevitably have become over-stretched and "paralysed" if the movement of the joint had not been limited.

A study of cases such as these has led the writers to modify their procedure in the course of the last few years. It may be laid down as a rule that arthrodesis of the ankle-joint should not be performed before the child is eight years old at least, and then only after the muscles have been given every opportunity of recovery.

Assuming that proper treatment has been adopted to obtain all possible recovery of muscles, operation may be of advantage in various ways as follows:

(1) In cases where the muscles are so completely paralysed that the foot dangles like a flail, operation to ankylose several joints may make the foot solid enough to carry the body weight without splints or apparatus, or with the aid of comparatively light apparatus.

(2) In cases less severe, in which there is power in some muscles, tendon transplantation and partial arthrodesis, backed up by a light apparatus, may give a more useful foot than if the joints were more completely ankylosed, even though apparatus might then be dispensed with entirely. It is only by experience that the surgeon can learn when to refrain from further operative procedure, and when to proceed boldly to complete ankylosis.

(3) There are cases in which there is weakness in one direction, say valgus. Such cases may get on very well with apparatus, but operation may enable the patient to discard braces, for instance by transplanting half the tendo Achillis into the tibialis posticus and removal of a wedge from the astragalus (*vide infra*).

Apparatus which is to be worn permanently in cases where no further recovery of muscles is possible should be made as light as is consistent with security. Temporary apparatus, worn while the surgeon is waiting to see how much recovery will take place in muscles before deciding on the nature and extent of operation required, should not be too light. Experience has shown that the exercise of swinging a moderate weight is beneficial to the limb and improves its musculature.

With these preliminary remarks we may proceed to deal with various common types in detail.

Paralytic Equinus or Dropped-foot.—As already pointed out, the pressure of the bedclothes is a considerable factor in producing over-stretching of the extensor group, hence this is one of the most frequent paralytic deformities of the foot. Most often it is combined with varus. It must be noted that while the foot is in the position of equino-varus when hanging free, it is usually in a position of valgus when the patient stands on it.

In the simplest form the foot is dropped at the ankle-joint from weakness of the extensors. The tendo Achillis may be shortened.

Treatment.—If there is any sign of power in any of the extensor group some recovery at least is possible. 1. The first stage of treatment, therefore, is fixation of the foot at a right angle or less. The tendo Achillis may have to be divided if it prevents the foot from being put in this position, but not otherwise (*see* Paralytic Cavus). After six weeks' fixation, preferably in plaster of paris, the limb is again examined. If there is recovery of power in any of the extensors the same treatment may be repeated, or the second stage may be begun. This consists in wearing a boot with a right-angled brace let into the back of the heel, extending well into the waist of the boot, and up to below the knee, and wearing a right-angled splint at night. When changing from the one splint to the other the foot must be kept at a right angle, so that the extensor muscles are never stretched.

If the recovery of the extensors is not sufficient to restore the muscular balance of the foot, arthrodesis of the ankle is performed from the front, with excision of an oval area of skin.

In order to meet the difficulty caused by carelessness of "out-patient mothers" when changing the day and night splints, we began about nine years ago to excise an area of skin over the front of the ankle-joint in cases of paralytic dropped-foot. When the foot has been put in the required position at right angles to the leg the surgeon picks up the loose superfluous skin in front of the ankle in a transverse fold; after marking off the amount that is redundant, a corresponding oval area is excised along with the fascia. When this oval wound is closed with sutures so as to form a transverse linear scar it acts as a splint, preventing the foot from dropping.

Thus, even if the mother of an out-patient is careless, the shortened skin saves the extensors from being stretched.

Arthrodesis of the front of the ankle-joint is performed as follows: An oval area of skin is excised. The extensor tendons are separated, and the joint capsule is opened in front. With a sharp gouge as much of the cartilage as can be reached is cleared off from the tibia and astragalus. The bone surfaces are brought into apposition, and the wound in the capsule is closed. The oval gap in the skin and deep fascia is now carefully closed, while an assistant holds the foot up in the required position, and the foot is put up in a club-foot shoe or in plaster of paris. On the eighth day the stitches are removed, and the patient can be sent away in plaster of paris for three weeks or a month to let the union become solid.

The after-treatment is that already described, namely, wearing a right-angled brace in the back of the heel of the boot and a night splint to keep the foot at right angles. When a sufficient time has elapsed these may be left off. This period necessarily varies with the degree of recovery in the muscles.

In cases with only slight paresis we content ourselves with arthrodesis of the ankle, for the muscles will become strong enough to control the mid-tarsal joint. If, however, the paralysis is complete we perform arthrodesis at the mid-tarsal joint at the same time. The same oval incision exposes both joints.

Pes Cavus, High Arch, or Hollow Foot, is a condition marked by an exaggeration of the arch of the foot. The patient walks on the heel and the heads of the metatarsals, the toes are often dorsi-flexed, and the tendon of the extensor hallucis in particular is often very prominent on the dorsum of the foot over the metatarso-phalangeal joint. Painful callosities are formed on the ball of the foot and over the dorsum of the toes. There is often some equinus, so that the patient walks on the ball of the foot and has difficulty in bringing the heel to the ground. The foot, however, is flexed at the mid-tarsal joint and not at the ankle-joint. Some of these cases are congenital, and may occur in families where a very high arch is hereditary. Such cases are hardly to be regarded as pathological. Most cases only come for treatment at puberty or in early adolescence, complaining of pain in the feet and a difficulty in walking any distance. Nearly all these cases are probably the result of a transitory paralysis in childhood. It may be impossible to get a definite history of an acute illness. Nevertheless, the extensor group of muscles is weak, for the patient cannot dorsi-flex the foot beyond a right angle, and in consequence contracture has occurred. in the muscles and fasciæ in the sole of the foot. A very common mistake is to divide the tendo Achillis to correct what appears to be an equinus deformity. The only effect of this is to let the heel drop and increase the cavus.

Treatment.—The structures in the sole must be stretched, preferably under an anæsthetic, and tight bands in the plantar fascia must be divided in the same way as in treating congenital club-foot. The tendo Achillis is next divided. The foot is then put up in plaster of paris in the dorsi-flexed position for from two to four weeks, to let the extensors shorten and strengthen. After this the patient wears boots with practically no heel and a bar across the sole to tip up the toes and let down the heel. The sole of the boot must be flat and stiff, or this device will not act. At night the foot is put in a right-angled splint (a club-foot shoe does very well), and the arch of the foot is bandaged or strapped firmly down to the footplate so as to prevent the sole from curling up during sleep. It must be remembered that a similar deformity occurs later in life in cases of Friedreich's ataxy and some of the allied forms of paralysis. Such cases are to be treated in the same manner, for although the paralyses of this group are progressive, as a rule the progress is slow, and patients are very grateful for the relief afforded by treatment, enabling them to walk with comfort on a flat sole instead of on a cramped foot.

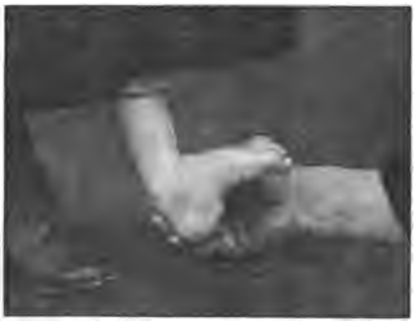

FIG. 46. — *Before treatment.* Paralytic calcaneo - cavus. Showing "dropped heel."

Operation on Bone.—In very advanced cases it is necessary to excise the heads of all the metatarsals except the fifth to get rid of the pressure of these bones on the sole. We generally do this by a single large plantar flap. The foot is necessarily shortened by the operation, but the pain is relieved. The after-treatment is as above.

Paralytic Talipes Calcaneo-Cavus.—Pes cavus of the type usually recognised as paralytic is a very different condition, for in these cases there is no doubt about the presence of polio-myelitis. There is a dropped-foot, but the drop is at the mid-tarsal joint, not at the ankle. The heel is not drawn up but is dropped, so that the axis of the os calcis is almost in line with the tibia (Fig. 46). There may be a deep fold across the instep. The tendo Achillis is too long, and will require to be shortened. The bony changes may be great, as depicted in the X-ray print (Fig. 47).

Treatment must be undertaken in different stages: First, the deformity of the foot itself must be corrected by obliterating the cavus and bringing the forepart of the foot into line with the os calcis; second, the calcaneus deformity must be corrected by bringing the foot to a right angle with the leg.

Operation.—First Stage: Correction of the cavus deformity. The plantar fascia is stretched, or divided subcutaneously if necessary. The foot is now to be put into extreme dorsi-flexion to bring it into proper line with the os calcis.

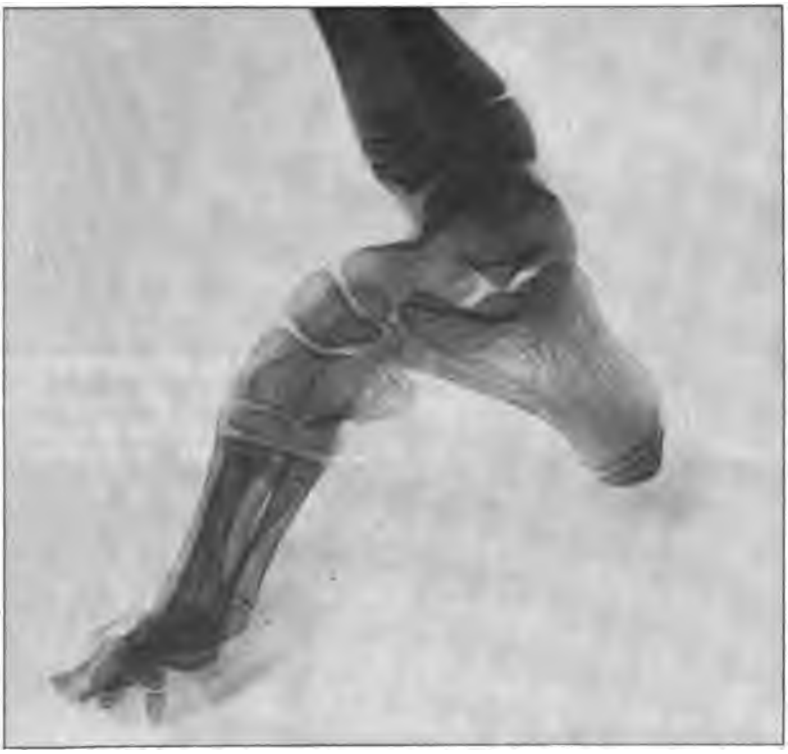

FIG. 47.—Case of paralytic calcaneo-cavus.

(1) If there be little deformity of bone it may be possible to bring the foot into this position. All that is then necessary is to perform arthrodesis of the astragalo-scaphoid joint, by opening it and gouging away the cartilaginous surfaces.

(2) Very often the deformity of bone is so great that the foot cannot be brought into line with the os calcis until a wedge of bone with the base upwards has been removed. An incision about 3 inches long with its centre over the angle of the convexity is made along the inner side of the foot down to the bone. With a

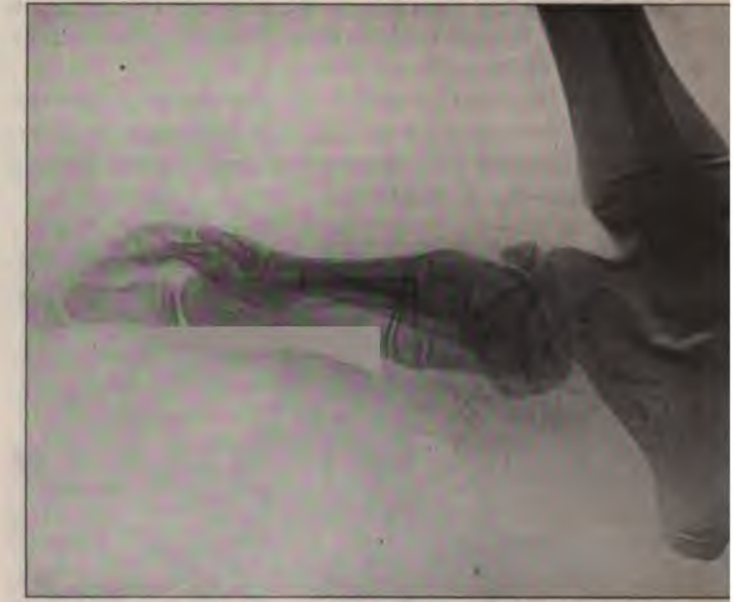

FIG. 48.—Paralytic calcaneo-cavus. First stage. The cavus is correct

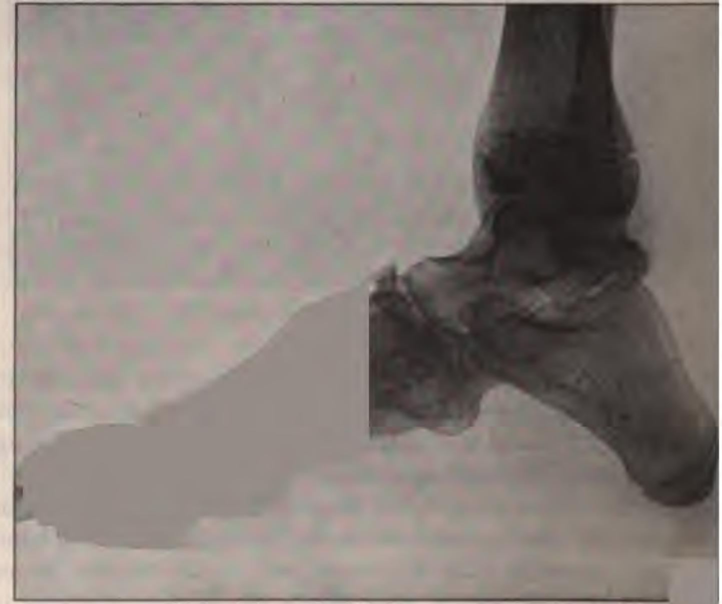

FIG. 49.—Paralytic calcaneo-cavus. Second stage. The calcaneus also cor

To correct valgus the base of the wedge is internal, and to correct varus it is external, or the wedge may be removed from the side of the astragalus. In dealing with severe calcaneo-valgus deformities the removal of such a wedge is essential.

Tendon Grafting and Transplantation, and variations in procedure supplementary to the operations described, will suggest themselves to the surgeon in connection with individual cases.

Some examples of these procedures are now given: (1) The area of skin excised is more to the outer side of the foot in cases with associated varus deformity and more to the inner side in cases of valgus; (2) in cases of equino-valgus with a strong gastro-cnemius and soleus the tendo Achillis may be exposed by a long incision and then split into two lateral halves, and the inner half separated from its attachment and fixed into the inner aspect of the os calcis or grafted into the tibialis posticus. The remaining half is divided or lengthened and the foot put up in the fully corrected position, and plenty of time allowed for consolidation of the union before allowing movement, for recent scar tissue stretches easily; (3) in cases of dropped-foot at the mid-tarsal joint the tendon of the extensor proprius hallucis is often strong and may be divided and inserted into the inner side of the cuneiform or the base of the first metatarsal to reinforce the action of a weak tibialis anticus; (4) in some cases of calcaneus, or in the second stage of the operation for paralytic cavus, instead of arthrodesis of the ankle-joint from behind it may be sufficient to reinforce the tendo Achillis by grafting a strong peroneus or flexor longus digitorum into it or by implanting the tendons of one or both these muscles into the back of the os calcis.

In planning such transplantation operations due attention must be given to the conditions present in each individual case. If a strong muscle is to be transplanted into a new position the following questions must first be asked: (1) Is there some other muscle capable of sufficiently performing the duty now performed by the muscle in question? (2) Is the muscle performing a useful function in its present position? (3) If transplanted will the functional result be better than that obtained by ankylosing the joint?

An excellent operation in cases of paralysis of the peronei is transplantation of the tibialis anticus to the outer side of the dorsum of the tarsus and of half the tendon Achillis into the outer side of the os calcis.

Arthrodesis is a very useful operation at the ankle and tarsus, but it is only to be employed in rare cases for other joints. It should never be performed before the child is eight years old, and results are still better if it is postponed till the child is over ten. In the meantime apparatus, massage, and exercise are carefully employed to bring the limb into the best possible condition.

VIII. SPASTIC PARAPLEGIA. *See* Paraplegia.

ROBERT JONES and D. McCRAE AITKEN.

Reference.

[1] "Manual of Physical Training," 1908. Price, 1s.

CERTAIN AFFECTIONS OF THE CHEST AND RESPIRATORY SYSTEM.

ASPHYXIA.

Although asphyxia means literally an absence or cessation of the pulse it has come to signify amongst all medical men the condition into which living animals quickly pass when their tissues are no longer supplied with oxygen. Although the accumulation of carbonic dioxide in the circulation seriously affects the system, the essential feature of asphyxia and the actual cause of death is deprivation of oxygen.

Two stages are recognised in asphyxia, the first or livid; the second or pallid stage. In the first the respiratory and vasomotor centres are not yet paralysed; the veins are engorged, the skin livid in colour, but the pulse is clearly felt, and breathing and consciousness return spontaneously. No special treatment is really necessary. In the second or pallid stage the respiratory and vasomotor centres are paralysed, the blood pressure has fallen, the heart's action is irregular and not easily detected. It is the treatment of this later stage which requires our attention here.

Forms of Asphyxia.—Asphyxia may be produced in many ways, but in the ordinary routine of practice it is usually met with in one of the following forms:

(1) Drowning.
(2) Strangulation.
(3) Choking.
(4) Compression of the thorax: overlying, etc.
(5) Coal-gas or carbon monoxide poisoning.
(6) Narcotic poisoning.
(7) Asphyxia of the new-born.

General Principles of Treatment.—Although the treatment of the various forms of asphyxia differs in detail, yet the principles on which we act to secure recovery are the same for all classes of cases. Attention must be chiefly directed to the central nervous system, especially to the vital centres of the medulla, for of all parts of the asphyxiated body the nerve centres are the most vulnerable and the first to pass into a state of death. Crile and

Dolley found that they could easily restore the circulation in animals ten minutes after asphyxiation had been produced, but the nerve centres could not then be resuscitated. Only under the most favourable conditions is the death crisis in the medullary centres prolonged beyond six minutes from the occlusion of the trachea. Ch. Richet has estimated that in an average individual the supply of oxygen in the lungs and blood is exhausted in three minutes from the time the air supply is cut off; the nerve centres apparently cannot withstand a *complete* deprivation of oxygen beyond a period of two or three minutes. Treatment in asphyxia must be prompt; oxygenated blood must be supplied to the central nervous system as quickly as possible. The circulation provides the only means by which this can be effected. The essential treatment of asphyxia then is: (1) The introduction of air to the lungs by artificial respiration; (2) the assistance of the heart and circulation by compression of the body and other means to be given in detail. The methods of artificial respiration now in use serve both purposes: air is introduced into the lungs; the blood is forced onwards. Although the aëration of the blood is the chief aim, it is more convenient to consider first the methods at our disposal for assisting the circulation.

Means of Restoring the Circulation.—For the restoration of the circulation a renewal or invigoration of the heart's action is the first necessity. Oxygenated blood is by far the best cardiac restorative; it not only brings the supply of oxygen of which the heart stands in need, but washes away the blood overladen with carbon-dioxide, which Hill and Flack have shown to have a direct and depressing action on the cardiac tissues. So long ago as 1865 Benjamin Ward Richardson showed that the heart of a child might be resuscitated by the circulation of an oxygen saturated solution twelve hours after death. In 1906 Crile and Dolley resuscitated asphyxiated animals by injecting such a solution into the carotid artery. In order that the solution may reach the coronary arteries and the heart, they found that a pressure of at least 30 *mm. Hg.* was necessary in the carotid. Such a solution also reaches and vitalises the nerve centres as well as the heart. In emergency cases we cannot hope to have such means at our instant disposal; we must rely on oxygenated blood reaching the heart from the lungs.

To ascertain how far we may assist the right ventricle in forcing blood from the lungs to the heart it is necessary to examine the condition of the circulation in cases of asphyxia. In the later stages of this condition the chief block in the circulation occurs in the capillaries of the lungs. In all forms of asphyxia where the entrance of air to the lungs is prevented, the normal respiratory movements which assist the passage of the blood through the lungs are replaced by ineffective efforts. These violent respiratory movements subject the thoracic contents to great positive and negative pressure. Two results ensue: (1) The air cells in the dorsal and deeper parts of the lungs become more or less collapsed, while those in the anterior (sterno-costal) and diaphragmatic parts become distended and emphysematous, and even ruptured (*see* references, Tendeloo, Mackenzie, Keith); (2) the capillaries of the lungs, especially in the collapsed parts, become greatly distended and frequently rupture into the alveoli. The right ventricle, becoming rapidly weakened by the supply of impure blood, is unequal to the pulmonary resistance; it becomes overladen and distended. The right auricle and the venous system become engorged. When pressure is applied to the thorax and belly of an asphyxiated animal the engorged venous chambers are compressed; blood from these chambers can be forced through the lung, becoming thus oxygenated (if air has been introduced into the lungs) and carried to the left side of the heart. Thus our chief means of assisting and restoring the circulation are: (1) The introduction of air to the lungs; (2) the compression of the body. Both of these measures are united in the methods used for artificial respiration. The injured condition of the lungs of the asphyxiated forbid the application of rough mechanical treatment; the writer is convinced that a considerable percentage of the asphyxiated are killed by the application of too vigorous means.

Blood-letting and Heart Puncture.—There is no doubt that the right heart is over-distended and depressed in cases of asphyxia. The means just proposed for its relief is compression of the body, but amelioration may also be obtained by opening the external jugular or basilic vein and withdrawing 12 to 16 oz. of blood. The valves between these veins and the heart appear to become incompetent when the venous system is overfilled. During the later decades of the eighteenth and the earlier decades of the nineteenth centuries blood-letting was a routine treatment in cases of asphyxia. Observer after observer records the immediate improvement of the heart's action and the early return of consciousness. Many modern medical men advocate this treatment, but in the writer's opinion those cases which respond so well to blood-letting are also the cases which recover rapidly by the ordinary means of compression. Direct puncture of the heart has also been used in moribund conditions, giving at least a temporary improvement of the patient (Milne). The right ventricle may be most suitably punctured at the left edge of the sternum in the fifth intercostal space. Sir A. E. Wright proposed that an artery should be opened; in resuscitating asphyxiated dogs he found he could effect a greater percentage of recoveries if he opened a major artery before performing artificial respiration. It is difficult to explain such a result, because in the later stage of asphyxia the arterial pressure has fallen greatly below the normal; the left ventricle is not overloaded like the right; it is depressed from oxygen-want and carbonic dioxide excess.

Administration of Oxygen and Adrenalin. — Priestly discovered oxygen in 1774; two years later John Hunter proposed its administration in cases of asphyxia; this practice was vigorously advocated by many men from Hunter's time until now (*see* references under Keith). There can be no doubt that oxygen is the best heart restorative in cases of asphyxia; in the great majority of cases we cannot command an instant and special supply but must rely on the ordinary quantity contained in the atmosphere. It is essential, however, that such a supply should be at the disposal of those specially engaged in resuscitation work. Oxygen is best administered by an inhaler or mask. Crile and Dolley found that resuscitation of asphyxiated animals was facilitated by the injection of 2 c.c. of a saline solution of adrenalin (1 in 1,000) into a major artery before commencing artificial respiration. The practice is designed to raise the blood pressure by bringing the paralysed vasomotor mechanism again into action. The use of adrenalin has a sound scientific basis and may be employed with advantage in all serious cases of asphyxia.

Other Mechanical Aids to the Circulation.—Although the compression obtained by the methods of artificial respiration are those on which we must rely to assist the heart, there are several minor aids which may be used with advantage, especially after the circulation has been partly restored: (1) Elevation of the limbs and lower part of the body; (2) an abdominal bandage; (3) rubbing, friction and massage of the limbs and body; (4) slight elevation of the head except during the performance of artificial respiration. (5) Inversion of the body has been practised; in the earlier stage of asphyxia and in newly-born or young children this practice may be attended with success, but its application to serious and to adult cases is more likely to do harm than good.

Direct Compression of the Heart.—In those cases in which surgeons have resorted to direct compression of the heart the condition has been one of syncope rather than of asphyxia. The surgeon inserts his hand below the diaphragm by a wound made in the upper part of the linea alba and rhythmically compresses the heart against the anterior wall of the thorax. Such practice in the treatment of asphyxia is justified only when artificial respiration cannot be carried out and where a wound already gives access to the sub-diaphragmatic region.

ARTIFICIAL RESPIRATION.

The best Method.—At the present time artificial respiration may be effected by a number of ways. The inventor and advocates of each method have been able to report numerous cases of successful resuscitation. Such statistics do not assist us in deciding which is the best method, because the percentage of recoveries published by the Royal Humane Society was as great, or greater, between 1832—1851, when all methods of artificial respiration were discontinued. The truth is that in the earlier stages of asphyxia artificial respiration merely hastens, but does not secure, a recovery; it is in the serious cases of the later or pallid stage of asphyxia that artificial respiration may be the determining factor between life and death. Artificial respiration should be applied to all cases because the stage of asphyxia in any particular case cannot be determined with certainty; we must not claim credit for the recovery in every case. We must determine the best method on theoretical grounds. It must insure a sufficient renewal of the air content of the lung and a circulation of the blood through the lungs, heart and brain; it must be simple, easy and free from danger to the patient. Schäfer's method comes nearest to the ideal; it is simple, can be carried out by a single individual over a considerable lengh of time; it assists the circulation; it supplies a limited but sufficient renewal of pulmonary ventilation. Other methods, like those of Silvester, Marshall Hall and Howard, provide, in the opinion of the writer, a more efficient ventilation of the lung and give greater assistance to the pulmonary circulation, but they are more laborious and less simple. In certain cases of operation where the patient cannot be placed in the position necessary for Schäfer's method and in others where a sufficiency of expert assistance is at hand, the Silvester or Howard method may be employed with advantage.

Schäfer's Method.—In 1903 Professor Schäfer introduced the method of artificial respiration represented in Figs. 1 and 2. The patient is placed prone so that the thorax rests on the floor; the head is turned slightly on one side with the arms extended forwards on each side of it (*see* Fig. 1). The operator kneels astride the patient's buttocks, extends his arms and rests his hands on each side of the patient's body over the lower pairs of ribs (ninth to twelfth pairs). By raising himself forwards on his arms the operator brings his weight to bear on the lower dorsal region of the patient (Fig. 2). An expiratory movement is thus produced; the contents of the thorax are compressed; air and other contents of the respiratory passage are forced out and the blood in the veins and heart is thrust onwards. As soon as the thorax is compressed the operator withdraws his weight by returning to his original position. The thorax of the patient, by virtue of the resiliency of its walls, tends to assume its former dimensions when the compressing force is withdrawn. An inspiratory movement is thus initiated by the rebound of the chest wall. The operator applies this method of compression fifteen to twenty times per minute.

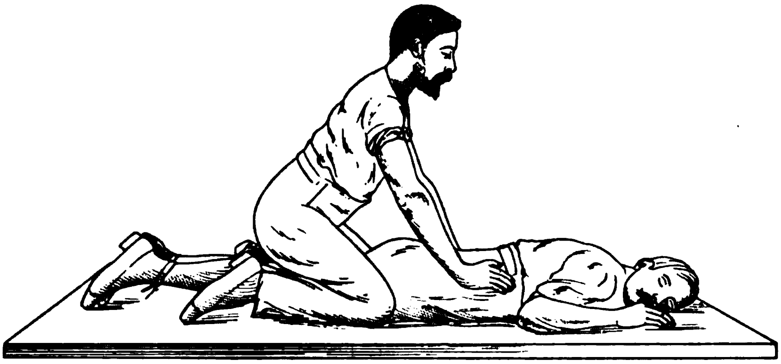

FIG. 1.—Showing the position of the patient and operator in the first movement of Schäfer's Method.

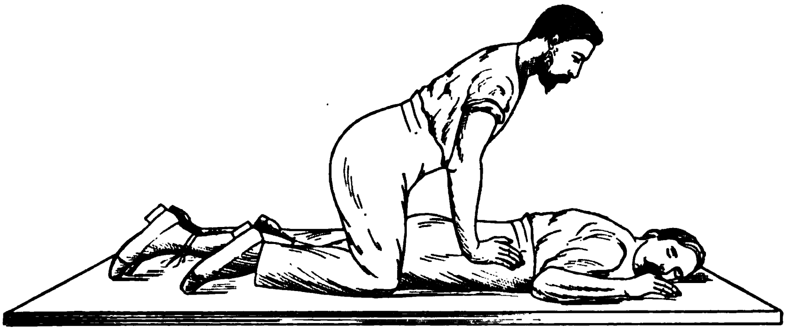

FIG. 2.—Showing the position of the patient and operator in the second movement of Schäfer's Method.

The sound of the air, as it escapes and enters, will keep him informed as to the efficiency of his efforts. The fragile and distended condition of the liver and spleen and the necessarily impaired condition of the lungs require that the operator's weight be applied with firmness, but also with discretion.

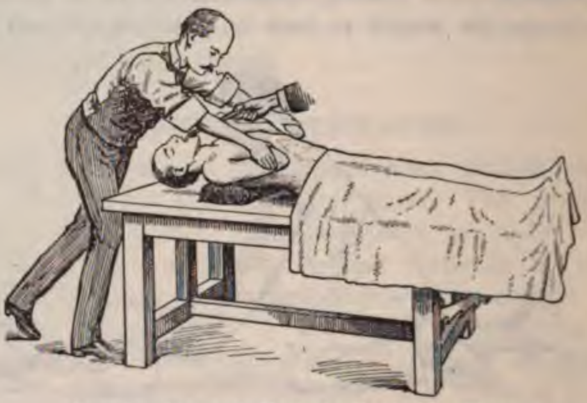

FIG. 3.—Silvester's Method: Expiratory Phase.

Silvester's Method.—In 1858 Dr. H. R. Silvester introduced the method illustrated in Figs. 3 and 4. The patient is placed on his back on the ground or floor or on a table or bench if such convenience be available. All heavy clothing must be removed from the arms and chest. A pillow or folded coat placed under the patient's shoulders serves the double purpose of expanding the chest and extending the neck, so that the tongue is less likely to

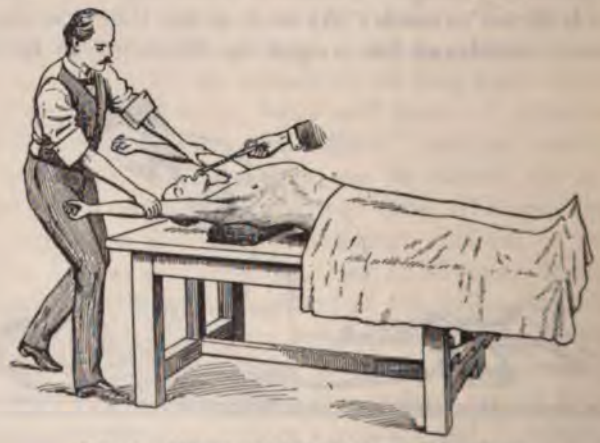

FIG. 4.—Silvester's Method: Inspiratory Phase.

obstruct the entrance to the larynx. The first movement should be that of expiration; the operator standing or kneeling at the patient's head, seizes the patient's arms at the elbows as shown in Fig. 3 and compresses the arms against the chest; fluid and froth in the upper passages are thus forced from the patient's mouth and nose, which should be turned so as to permit their free escape. As soon as pressure is withdrawn from the chest the inspiratory expansion begins, owing to the resiliency of the walls; this movement is greatly increased by extending the patient's arms as shown in Fig. 4, until they come to rest at each side of the head. The arms are used as chest levers; their extension secures an expansion of the thorax by means of the pectoral attachments. To obtain this expansion of the chest it is absolutely essential that the operator, as he raises the patient's arms upwards, should prevent them from rotating inwards and thus relaxing the pectoral muscles. He must measure the results of his efforts by the audible passage of the air current. Having raised the arms and secured an inspiratory movement, the operator returns them to the expiratory position. These movements are repeated from fourteen to sixteen times per minute. The method is more laborious and less simple than Schäfer's, but secures a better ventilation of the lung and is less likely to injure the lungs and abdominal viscera. In Fig. 5 is represented a modification of the Silvester method by Brosch; instead of arresting the upward movement of the arms at the side of the head he continues the movement until the spine is extended. Meyer and Loewy found that they could fill the lungs with 1,000 to 3,000 c.c. of air with each of such forced movements. Schäfer

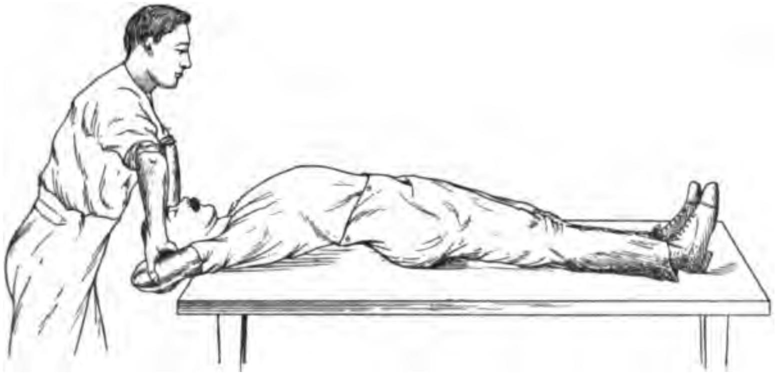

FIG. 5.—Brosch's modification of Silvester's Inspiration Phase.

regards an exchange of 5,000 to 6,000 c.c. of air per minute as sufficient for the purpose of resuscitation.

Howard's Method.—The method introduced by Dr. Benjamin Howard, of New York, in 1871, has certain merits and is often employed. The method is shown in Figs. 6 and 7. The patient, in cases of drowning, is at first placed on his face, when his thorax is compressed as in the Schäfer method. He is then turned on his back (Fig. 7) with a pillow under the shoulders to extend the spine and expand the chest. The operator kneels over the patient or at the side and operates as in Schäfer's method, except that he rests his palms over the cartilages of the seventh, eighth and ninth ribs.

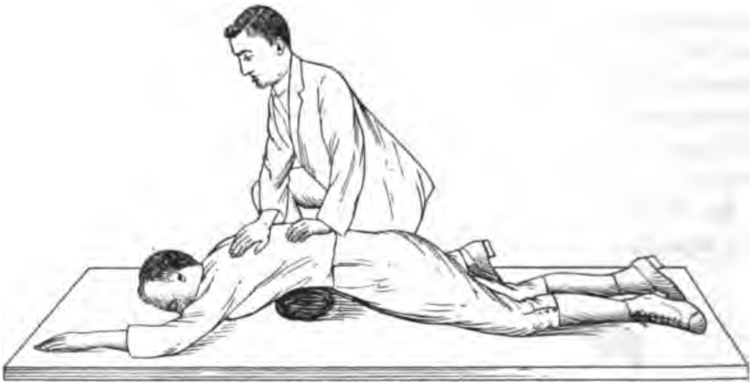

FIG. 6.—Howard's Method: Preliminary Compression.

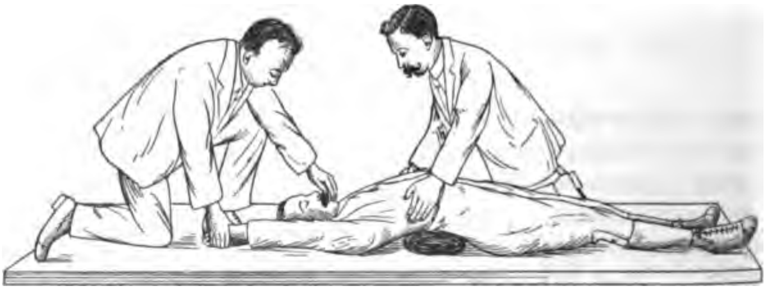

FIG. 7.—Howard's Method: Posture of patient and operators.

Schüller's Method is a modification of Howard's; the operator stands or kneels over the patient's head and inserts his fingers under the cartilages of the seventh, eighth and ninth ribs, and produces an inspiratory movement by drawing these towards the patient's shoulders and secures an expiratory movement by pressing them inwards; in Howard's method the active movement is an expiratory one, in Schüller's an inspiratory.

Other Methods of Artificial Respiration.—The oldest method of applying artificial respiration is by mouth-to-mouth inflation. This method is especially suitable for children. The child is placed on its back; the operator placing one hand on the epigastrium, uses the other to steady the head and occlude the nostrils. When the epigastrium is felt to expand, expiration is assisted by pressure of the hand. Inflation by means of bellows, effective in skilled hands, is seldom now used (Keith). Dr. George Fell strongly advocates the performance of tracheotomy and the use of bellows, such as are employed in physiological laboratories, for resuscitation in cases of narcotic poisoning.

Accessory Measures.—*The application of warmth and maintenance of the body temperature* are important parts of the treatment of asphyxia. For a considerable period cases of asphyxia treated by the officers of the Royal Humane Society were immersed as soon as possible in hot baths (temperature 100° to 105° F.) until the functions of the body returned. Such treatment, although successful in early cases, is not likely to prove so successful as artificial respiration with the application of warmth by means of dry clothing, warm blankets and hot bottles or bricks wrapped in flannel. The patient should not be placed in a draught, but the surrounding air should be fresh and, if possible, warm.

Reflex Stimulation of the Nerve Centres forms a part of all methods of treatment, but clearly such methods as holding solutions of ammonia to the nostrils, the application of a mustard leaf, or of a sponge or cloth wrung out of very hot water to the præcordium, and flicking the skin with towels, are most likely to be helpful in the earlier rather than in the later stages of asphyxia where there is profound paralysis of the nerve centres.

Rhythmical Traction of the Tongue, often described as Laborde's method, is successful in stimulating the respiratory centre. The mouth is opened, the tongue seized and drawn outwards until the traction also affects the larynx and trachea. The movement is repeated fifteen to twenty times per minute. Laborde was the first to apply this method to the resuscitation of the apparently drowned.

Another measure which was popular for many years was the injection of tobacco fumes per rectum (*see* references, Keith). No attempt should be made to force hot or stimulating drink or food on the patient until consciousness returns. In very few cases is the administration of nourishment urgently necessary. In cases which recover slowly enemata of beef-tea may be given with advantage.

After-treatment.—In a considerable number of cases of asphyxia death occurs after a temporary recovery. In some the cause of death is obscure; heart failure is a common cause; in others, especially in cases of drowning, air embolism, pulmonary thrombosis or pneumonia may supervene. It is therefore necessary to watch cases of asphyxia which have apparently recovered very closely for at least twenty-four hours. Rest in bed, warmth, liquid nourishment and cardiac stimulants are the most likely means to secure a complete recovery.

TREATMENT OF SPECIAL FORMS OF ASPHYXIA.

(1) **Drowning.**—As soon as removed from the water the patient is laid face down on the ground or bottom of the boat, and artificial respiration performed according to Schäfer's method. The first pressure over the lower dorsal region will show by the escape of froth from the mouth if the passage is clear and the method effective. See that the mouth is free of the ground and clear of foreign matter. It is said that the contents of the stomach may be ejected by the pressure on the loins, and it is necessary to see that such matter is not inhaled. See, too, that the clothing is free round the neck, and if assistance is at hand remove the heavier clothing from the chest, keeping the patient on his face and lifting him first by one shoulder and then the other. If there is no clear evidence of escape and entrance of the air, especially in people over fifty and in children under five, in whom the resiliency of the chest may be insufficient, turn the patient on the back, head extended and to the side, and proceed to carry out Silvester's method. Indeed, if assistance is at hand, Silvester's or Howard's method will probably be found more effective from the commencement in very young and very old individuals. As soon as signs of spontaneous breathing occur proceed to have the wet clothes removed, rub the patient dry, and place in a warm bed as soon as possible with limbs and pelvis rather elevated. The heart is usually greatly depressed; as soon as consciousness returns teaspoonfuls of a warm solution of brandy and water may be given and treatment carried out as in a case of shock. Keep the patient in bed for at least twelve hours, or longer if the heart does not rally quickly. In very young children, up to the age of three or four, mouth-to-mouth inflation with pressure on the epigastrium will be found to be the most effective mode of artificial respiration.

(2) In cases of **Strangulation** remove the ligature or obstruction and proceed to treat as in cases of drowning.

(3) In cases of **Sudden Choking** lay the patient face downwards, across a chair, bed or pillow, or whatever is most convenient to make the head fall forwards, open the mouth and force the forefinger backwards to hook the epiglottis forward, and examine the entrance to the larynx. Press the lower dorsal region to force out the breath. If still unsuccessful, invert the patient, especially if young or small, and concuss the back sharply. Tracheotomy is a last resort and should be performed only in the most urgent condition. Artificial respiration will be seldom required in such cases.

(4) Cases of **Coal-gas and Carbonic Monoxide Poisoning.**—In such cases a full ventilation of the lungs is desirable. The most effective method is Brosch's modification of Silvester's method. If oxygen is available it should be administered during the performance of artificial respiration. Dr. Leonard Hill has suggested the addition of a 5 per cent. mixture of carbonic dioxide to stimulate the respiratory centre. He points out that this may be supplied by the method of mouth-to-mouth inflation, the breath supplying the additional CO_2.

(5) Cases of **Asphyxia** from the administration of anæsthetics should be treated similarly to the last group. The same applies to cases of narcotic poisoning.

(6) **Asphyxia in the New-born.**—Usually slapping with the hand or dipping the little patient in alternate baths of hot and cold water brings the respiratory centre into play. If not, Champneys recommends mouth-to-mouth breathing or manipulation by Silvester's method. Schultze's method has been much employed. The operator stands up and suspends the child between his legs by a forefinger slipped into each axilla from behind, the other fingers steadying the child's back. He then swings the child forwards and upwards until its body is flexed, the feet and legs falling towards its head. The first position is inspiratory, the second expiratory. The movement is repeated about fifteen to twenty times per minute. The method used by Dr. Buist is easier and quite as effective. The operator places the child face downwards across his extended right palm, so that the body is flexed, the feet and head falling downwards. He then transfers the child by a gentle throwing movement to the extended left palm, the child in this case being on its back and its body extended. The first position is the expiratory, the second the inspiratory. The movements are maintained at the rate of fifteen to twenty per minute.

ARTHUR KEITH.

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INJURIES OF THE CHEST.

FRACTURE OF THE RIBS.

Preliminary Considerations.—Although these injuries may be met with at any age they are most common in the prime of life and are much more common in men than in women.

Usually fracture of a rib or ribs produced by *indirect violence* is due to antero-posterior compression, and its commonest site is just behind the mid-axillary line, or between that point and the angle of the rib. The fragments will tend to burst outwards in this kind of fracture, and injury to the deeper structures is not common. The seventh rib and those in immediate relation to it above and below are most likely to be broken. Fracture due to *direct violence* may cause the broken ends to project inwards and produce injury to the pleura, lungs, kidney, etc. If one rib only is fractured, and that a "true" one, the displacement is very slight and in certain incomplete fractures it may be non-existent. Fracture may be produced by *muscular action, e.g.*, coughing and parturition.

In the treatment of these injuries it must be remembered that respiration requires movement of the thorax, and hence complete rest of the part is an impossibility. Thus, while the constant necessary movement of the heart and lungs interferes with repair, so a too stringent fixation of the chest may produce pulmonary complications, especially in the older victims of these injuries.

Complications.—The surgeon must bear in mind the varied and important injuries to the intrathoracic organs which may occur as the result of fractured ribs. More commonly the pleura and lung may be injured, also the pericardium, heart, great vessels, diaphragm, spleen, stomach, liver, kidneys and intestines. A diaphragmatic hernia may ensue or hernia of the lung. Again, injury to an intercostal vessel may result in a *hæmatoma of the chest wall* or bleeding inwardly may produce *hæmothorax*. When air escapes from an injured lung a *pneumothorax* is produced, and as the air also escapes into the tissues of the chest *surgical emphysema* may co-exist. The broken ends of the ribs if projected inwards may wound the lung and give rise to *hæmoptysis*, a symptom which may also result from serious compression of the chest wall, which in certain cases causes *contusion of the lung*. *Pleurisy* is generally present at the site of fracture. Where many ribs of one side have been broken that side may scarcely move at all, a fruitful source of *bronchitis* and *œdema of the lung* in the aged. Not infrequently bronchitis has been present at the time of the accident, and the patient's difficulty in emptying his bronchial tubes, owing to the pain and fixation of his injured side, is gravely increased.

Symptoms.—In these days of the Workmen's Compensation Act it will be found advisable to confirm the diagnosis by a skiagraph. The possession of such a document in all cases of fracture will prevent the terrors of giving evidence which exist where the surgeon is in doubt as to the correctness of his diagnosis.

Treatment of the Fractured Rib or Ribs.

(1) *In healthy adults* where only one or two ribs are fractured and there is little or no displacement and no projection inwards of the broken ends, no attempt need be made to set the fragments; a few deep inspirations will do all that is required.

Apply firmly three strips of plaster, about 3 inches wide, the central one covering the injury and the others crossing it. See that the upper border of these strips does not reach the axillary folds. The strips should extend from just beyond the middle line behind to just beyond the middle line in front, and should be applied immediately before the inspiratory effort is begun.

No further fixation of the affected side is needed, nor is it wise to apply a rib roller round the chest. The patient may be allowed to get about from the first, and daily massage over the strapping should be performed, the chief action of the hand being from the back of the chest towards the front. In a small minority of cases, where there is great pain, an ice-bag applied to the part, with rest in bed for a few days and the judicious use of morphine, may be required.

(2) *When the broken ends of the rib project into the lungs* it may be necessary to cut down upon the fracture and deal with the condition as is found suitable; but this is required very rarely indeed. If there is a suspicion only of inward pressure of the fractured ribs, strapping should be avoided.

(3) *In old people liable to bronchitis* or in subjects already suffering from this malady, fixation should be avoided as far as possible. It is best to keep them in bed and well propped up for a few days till the shock of the accident has passed off. While they are in bed see that their position is changed three or four times a day, so that sometimes they are propped straight up, sometimes they lie on one side, sometimes on the other. Above all it is important to allow them to sit up as soon as possible. Unless

there is some definite contra-indication, morphine may be administered, for it eases pain, gives the patient sleep and diminishes the cough.

(4) *When ribs on both sides are fractured* or where there are many ribs fractured on one side it will generally be found advantageous to confine the patient to bed and to let him find the most comfortable position for himself. The pain involved in respiration will cause the patient to limit movement for himself as much as possible. After a few days, provided that there is no bronchitis and if one side only is affected, strapping may be applied from below upwards in 3-inch strips projecting beyond the middle line both in front and behind. Morphia may be administered with the precaution above mentioned.

(5) *When the fracture is compound.*—This injury is not common, and when it occurs the pleural cavity is opened and some of the complications mentioned above may be present. Treat the fracture on the usual lines for compound fracture.

Although a considerable amount of care must be taken to disinfect the wound, do not use strong antiseptics. If septic infection has already occurred and involved the pleura excise the broken ends of the ribs and treat as in a case of empyema.

Subsequent Progress and Prognosis.—Usually fractures of the ribs will unite in three or four weeks. From the first, or in complicated cases after the patient is allowed to get up, all that is needed is for the patient to carry his arm in a sling for a week or two and to avoid violent exercises. During this period it will be found that regular massage will aid convalescence and more speedily get rid of any feeling of stiffness or intercostal pains. A broken rib is often looked upon as a trivial accident, but in old people, or those afflicted with pulmonary or visceral disease, a carefully guarded prognosis must be given.

Treatment of Complications.

For the lung complications, such as bronchitis, pneumonia and emphysema, the appropriate medical remedies must be applied. Pneumo- and hæmo- thorax will be referred to later.

Surgical Emphysema.—This is a complication which hardly requires active treatment. The writer has had under his care a boy, aged five, with emphysema extending from Poupart's ligament to 2 inches above the clavicle. The emphysema disappeared without treatment and with little or no embarrassment of the patient's respiratory movements in about three weeks. In fifteen years' experience at a general hospital he has never found it necessary to interfere surgically with this condition. Should the air escape high up into the deeper tissues of the neck it may be necessary to let it out owing to its interference with respiration. The skin can readily be incised in several places over the swollen area in the neck. The small incisions may be held open for a short time to allow the air to escape and then dressed antiseptically.

DISLOCATION OF THE RIBS.

This injury is rarely recognised in life, but the costo-vertebral joint is sometimes dislocated in severe crushes of the trunk. There is no special treatment for this condition, even if recognised, beyond that of such other injuries as are caused by the same accident.

FRACTURE OF THE COSTAL CARTILAGES.

An injury of this nature is more frequently met with in old subjects whose cartilages have become calcified and brittle. The costal end of the cartilage is the usual site of the fracture. The treatment is that of fractured rib.

DISLOCATION OF THE COSTAL CARTILAGES FROM THE STERNUM.

A very rare result of injury in this region and one in which the end of the cartilage usually protrudes in front of the sternum, though backward displacement of the cartilage is not unknown.

Replacement.—In anterior displacement of the cartilages make the patient lie upon his back with a firm pillow or narrow sand-bag between his shoulders and tell him to take a deep inspiration. A little manipulation during deep inspiration will usually effect reduction.

In backward displacement operation may be required with replacement, or, failing that, excision of the cartilage. After reduction the treatment is identical with that of fractured ribs.

FRACTURES AND DISLOCATION OF THE STERNUM.

The usual site of fracture of the sternum is at the junction of the manubrium and gladiolus. Fracture dislocation or true dislocation of the joint may be found with displacement forwards of the lower fragment.

Reduction may be effected by hyperextension of the upper thoracic vertebræ over a thick sand-bag. If the procedure does not succeed, in spite of manipulation, the surgeon may decide to leave the case alone. Should the displacement produce symptoms, the parts may be exposed and the depressed fragment got into position and held there, if found necessary, by a wire.

The Ensiform Cartilage may be fractured or bent backwards producing pain in the epigastrium and sometimes persistent vomiting and dyspepsia. If attempts at replacement, which is by no means easy, are unsuccessful, the cartilage may be cut down upon and enucleated from its perichondrium.

CONTUSIONS OF THE CHEST.

In the majority of cases these injuries are due to run-over accidents and falls.

Although the injury of the soft parts is generally not very great, it must be remembered that bruises and hæmatomata of the chest wall produced by run-over accidents in the London streets are very liable to become infected with micro-organisms in spite of careful antiseptic after-treatment.

Subcutaneous abscesses may form and the bruised parts should be inspected regularly to insure early evacuation of the pus if any be present. Neglect of this precaution has been followed in more than one case by septicæmia and pyæmia. Apart from injury to the soft parts, contusion of the thorax may be accompanied by fracture of the ribs or there may be serious internal damage without fracture.

Sometimes the contents of the thorax may suffer from concussion, a condition in which there is severe and fatal collapse.

A post-mortem examination in fatal cases has discovered no definite lesion of the thoracic contents. Such a condition may be due perhaps to injury to the vagus, or concussion of the spinal contents or paralysis of the sympathetic. In some cases there may be direct compression of the pericardial contents.

Treatment.—The patient should be placed in a horizontal position or the foot of the couch or bed should be raised. It may be necessary to restart respiration by artificial means. Should the patient be able to swallow, stimulants should be given by the mouth, otherwise brandy or ether may be injected subcutaneously. Restoration is assisted by applying friction to the surface.

WOUNDS OF THE CHEST.

Non-penetrating Wounds.—Hæmorrhage is the chief condition requiring treatment, but it will be found that where there is bleeding from the internal mammary or intercostal arteries there is usually a penetrating wound.

(1) *Wounds of the Internal Mammary Artery.*—An extremely rare accident, due to stabs with a knife or bayonet, and to gunshot wounds. Bleeding may be external or into the pericardium, pleura or anterior mediastinum. Where internal hæmorrhage is suspected note the position of the wound in conjunction with the signs of loss of blood. Remember that this vessel runs down ½ inch external to the outer border of the sternum as far as the upper border of the sixth rib.

To stop the hæmorrhage tie the wounded vessel above and below. Should an attempt to ligature the cut ends fail, even after enlarging the wound, plug the wound temporarily, make an incision upwards and downwards over the line of the artery, remove an inch of the costal cartilages above and below the wound of the vessel from the sternum outwards, expose the injured vessel, and apply the ligatures. It will be found a good rule always to drain these wounds. There may remain the results of hæmorrhage, viz., hæmothorax, hæmopericardium, with possibilities of wound infection to deal with afterwards.

(2) *Wounds of the Intercostal Arteries* are produced in a similar manner to the preceding and are equally uncommon. The hæmorrhage may be external or internal. The larger of the two vessels which runs along the lower border of the rib above is the one usually injured.

Make an attempt to seize the bleeding points by slightly enlarging the wound. If this is unsuccessful remove an inch to 2 inches of the rib above, completely detaching the periosteum. The vessel is thus exposed and the bleeding ends may be seized with clips, or underrun with a curved needle, and ligatured.

Penetrating Wounds.—As these wounds are produced by bullets, sharp instruments or severe contusions, the practitioner must bear in mind that numerous complications, such as injury to the lung, pleura, heart, pericardium, great vessels, diaphragm, œsophagus, thoracic duct with hernia of the lung, septic mediastinitis, empyema, etc., are possible, and that a very guarded prognosis should be given.

General Considerations.—Thoroughly cleanse the wound, being careful to avoid strong antiseptics. It is possible that some foreign body, such as a bullet, piece of clothing, or a portion of the stabbing instrument, may have been introduced. This should be found and removed if in a situation where removal is not too dangerous an undertaking. Shock must be treated with great caution. Put the patient to bed and let him lie on the injured side absolutely undisturbed. Avoid vigorous restorative measures, for the fall of blood pressure associated with shock will prevent hæmorrhage, and if stimulants are used too freely hæmorrhage from the lungs may occur which may be fatal.

Ice may be applied to the injured side and may be given to the patient to suck. With due precautions, morphia may be given hypodermically.

Wounds of the Pleura.—Here there will be some hæmothorax and pneumothorax. If only *slight*, cleanse carefully and close the pleural cavity with absorbable sutures, introduce a small drainage tube down to the sutured pleura and close the skin wound. If, however, there is free bleeding into the pleural cavity, enlarge the wound, clear out the clot and secure the bleeding vessel. Should the exact site of the hæmorrhage be unknown it is inadvisable to make an extensive search for the bleeding vessel, for the patient's strength will probably not stand a prolonged operation. Treat, therefore, generally as above.

Hernia of the Lung is rarely met with, but may occur at the time of the injury or later. It is generally the result of extensive injuries, and the prolapsed lung is caught between the ribs and held there. It becomes greatly congested from pressure and then gangrenous. Sometimes a hernia may develop from adhesion of the lung to the scar resulting from an injury or from emphysema. This condition is described as *consecutive hernia.*

Treatment.—(1) If seen immediately after the injury, carefully purify the surface of the exposed lung, free it gently, and reduce it into the pleural cavity. Then close the wound, leaving a drain in it.

(2) If seen later, when strong adhesions have been formed, reduction is impossible and should not be attempted. Adopt Hunter's advice to Jenner as regards a fungus of the brain, "Do not meddle with it—let it drop off"; and later, "Cut it off and be damned to it," only in this case a ligature should first be applied round the base of the prolapsed piece of lung tissue.

Empyema following Injury.—As soon as the diagnosis is made open the thorax and drain it, after excising a rib. If the infected portion of pleura is situated anteriorly, pass a director through the first opening backwards to the line of the angle of the scapula or to the most posterior limit of the cavity, excise a rib in this position, and drain.

The subsequent treatment is that for empyema.

Foreign Bodies.—These, if aseptic, may become encapsuled at the lower part of the pleural cavity. If septic, and not found and removed, they may cause empyema, abscess of the lung, or fatal septic pneumonia.

Treatment.—Localise with X-rays and remove if accessible. It depends upon the position of the foreign body as to whether you will approach it through the original wound or by making a fresh opening at a spot nearest to the object. When it is impossible to localise the body with X-rays, explore the sinus or track of the bullet, etc., very carefully. If it can be felt, remove it either from the original wound or through a fresh one in a suitable position. It will be found advisable to drain these wounds after removal of the foreign body. If the surgeon meets with these cases some time after the accident, encapsulation may have occurred, or an empyema or pulmonary abscess have been formed. These last must be treated as described later.

INJURIES TO THE CONTENTS OF THE THORAX.

Rupture of the Diaphragm.—This injury is usually part of a much more extensive one, and is more rarely caused by gunshot or stabbing wounds. Sometimes one or other of the viscera of the abdominal cavity protrude through the opening into the pleural cavity, producing what is called by some a diaphragmatic hernia. Accompanying this condition will be found symptoms indicating interference with respiratory movements and also certain abdominal symptoms, such as vomiting, and possibly other signs of strangulation. The symptoms will naturally vary according to the organ which has become involved in the hernia protrusion.

Treatment.—The abdominal cavity should be opened by an incision parallel to the costal margin and about a finger's breadth below it. The condition of the diaphragm and the abdominal viscera is immediately discovered, and after the displaced viscus has been reduced into the abdomen the tear in the diaphragm is sutured.

Diaphragmatic Hernia.—This condition of true hernia has usually been found accidentally when doing a laparotomy for intestinal obstruction or in the course of a post-mortem operation. The treatment is as in the preceding paragraph.

Injuries to the Pleura and Lung.—These are the commonest injuries to the contents of the thorax and occur in varying degrees of severity. In some cases the pleura covering the lung may not be torn and yet there is bruising and extravasation of blood into the lung. In others the visceral pleura is torn and blood and air pass into the pleural cavity, causing pneumo-hæmothorax. The outcome depends on the extent of the injury and the age and general condition of the patient.

As a matter of experience, recovery is the rule where there is no great amount of blood or air extravasated into the pleural cavity and in patients who do not suffer already from bronchitis and emphysema.

If there is much damage, with shock and hæmoptysis, there is danger not only from respiratory embarrassment but also from the risk of infection of the blood extravasated and the resulting inflammatory exudation.

Slight and Uncomplicated Injuries.—Absolute rest in bed must be rigidly enforced, and when the condition of shock has passed off the patient should be propped up in the position most comfortable to him. Apply cold to the injured side and administer morphine if there is much discomfort. Keep the patient in bed until all signs of pleural or pulmonary trouble have subsided.

Hæmothorax.—In this condition attention must be given to the relief of pressure. Cold may be applied to the affected side, and, if it is certain that an intercostal vessel is injured, steps should be taken to secure the bleeding points. Unless this is fairly certain nothing is to be gained by opening the thorax, for even if there is a tear of the lung or rupture of some pulmonary vessel, the operator's chance of discovering these lesions is very slight indeed when he has opened the thorax. It is to be remembered that the presence of blood in the pleural cavity limits hæmorrhage, and care must be taken not to make any attempt to withdraw the blood unless pressure symptoms are urgent. If it is necessary to withdraw some of the blood let the patient lie flat on the bed, take a trocar and cannula at least $\frac{1}{10}$ inch in diameter and push it into the thorax in the sixth interspace on the mid-axillary line. Let the fluid flow out and do not use an aspirator, but have a blunt trocar ready to introduce into the cannula and push away any clots which may be blocking its lumen. Advise the patient not to breathe deeply. Remove only sufficient to relieve the pressure, for the operation can easily be repeated if necessary.

Pyothorax may follow hæmothorax. Its treatment is that of empyema.

Pneumothorax.—This condition may be associated with hæmothorax or may occur with little or no extravasation of blood. It has been mentioned as a complication of fractures of the rib, severe contusions, penetrating wounds, and also in connection with tuberculous disease. Suppuration may occur with an open wound, but is otherwise very rare.

Generally pneumothorax resolves without much treatment beyond rest in bed, but if marked dyspnœa results the air should be drawn off with a trocar and cannula of small size. Leave the cannula in for a short time and dress antiseptically. Be careful to preserve strict asepsis so long as the air continues to escape, then remove the cannula and dress carefully.

Injuries of the Pericardium.—As a rule these are fatal owing to implication of the heart and great vessels. Sometimes, however, the parietal pericardium alone is involved in certain cases of fracture of the ribs, costal cartilages and sternum.

Treatment.—As regards wounds of the parietal pericardium, these should be carefully cleansed, drained and sutured. If it is thought that the wound is a clean one it may be closed entirely, but the surgeon must be on the look-out for subsequent infection. Cases have occurred of serious bleeding into the pericardial cavity. If there are any signs of hæmorrhage such as cardiac embarrassment due to pressure the wound must be enlarged and a drainage tube inserted. During the operation it may be possible to secure the bleeding points.

Injuries to the Large Vessels are immediately fatal and their treatment does not arise.

Injuries of the Heart may be caused by fractured ribs, stabs, bullets, rupture of the heart, or severe compression.

Rupture is associated with severe run-over accidents and is generally fatal either from shock, hæmorrhage, or hæmorrhage into the pericardium and compression.

Wounds of the Heart are, as a rule, penetrating wounds and may involve the auricles or ventricles. Their prognosis is bad, wounds of the auricle being the most fatal and wounds of the apex the most favourable to recovery.

Treatment.—Cases are on record, but they are few in number, in which the wound has been exposed by operation and sutured.

The heart may be reached by an incision beginning in the fourth left intercostal space ½ inch from the border of the sternum, and running outwards in this space for about 5 inches; then the incision is carried downwards from the outer end of the incision as far as the seventh rib. Remove the fifth and sixth costal cartilages, push aside the pleura and internal mammary artery (or divide the latter). If the pleura is wounded sew it up. Open the pericardium by a crucial incision, turn out the clot and suture the wound when found with catgut, passing deeply through the heart muscle but just missing the endocardium. Having finished the suturing, devote attention to the relief of the condition resulting from the severe hæmorrhage. Close the wound, leaving a drain down to the pericardium.

Injuries of the Mediastinum.—These are usually fatal owing to severe hæmorrhage and other serious and associated injuries.

H. S. PENDLEBURY.

INFLAMMATION OF THE RIBS AND STERNUM.

Osteomyelitis of the Thoracic Wall. — The acute form of osteomyelitis of the ribs or sternum is rare, but a more chronic form may follow enteric fever. It may also be found in association with active infective osteomyelitis in other bones, especially in children.

Treatment is identical with that of septic osteomyelitis elsewhere.

Expose the infected bone as soon as the diagnosis is made, let out the pus and leave the wound open. It is not advisable to excise a part of the rib but to wait until the sequestrum has separated. If, however, healing does not seem to be taking place after removal of the sequestrum, it will be best to remove all diseased parts of the rib affected.

Syphilis of the Ribs and Sternum.—Syphilis usually attacks the first rib near its junction to the sternum, and frequently the clavicle and sternum are also involved. Gummata are the most common manifestation of the disease and there is seldom much necrosis of bone.

(1) *Before necrosis has occurred* the free and careful administration of iodide of potassium and mercury will usually result in absorption of the gummata without the occurrence of necrosis.

(2) *After necrosis has occurred*, and if the wound shows no sign of healing in spite of anti-syphilitic treatment, it will be found best to remove the diseased bone and any sequestrum that may be present. Scrape away the infected granulation tissue and rub the raw surfaces thoroughly with iodoform emulsion, put in a drainage tube and sew up the wound. Healing is usually rapid and complete if anti-syphilitic treatment is continued conscientiously. Should it be impossible to bring the skin edges together the wound may be allowed to granulate, and healing may sometimes be assisted by skin grafts.

Tuberculous Disease of the Ribs, Rib Cartilages and Sternum.—This is a not uncommon trouble and generally begins underneath the periosteum in the neighbourhood of the muscular attachments. Frequently more than one rib is affected. The usual sites at which a rib is affected are (1) at the junction of the rib and its cartilage; (2) close to the sternum; (3) behind the posterior axillary line.

The disease begins insidiously and often there is no pain, so that the presence of a tumour is the first thing to draw the attention of the patient to the trouble. If caseation occurs, the abscess is usually situated on the external surface of the rib or sternum. The swelling must be distinguished from localised empyema, spinal abscess, subcutaneous abscess, softening gumma and sarcoma.

(1) *When the Rib is Affected.*—If possible, excise the abscess with the portion of diseased rib. This is best done by raising a flap of skin over the swelling, separating the surrounding tissues carefully from the abscess walls, and exposing the bone a little distance on each side of the diseased area. Divide the periosteum on each side of the diseased portion at right angles to the rib and divide the rib on each side of the abscess with bone forceps, taking care not to injure the pleura.

If the abscess is opened during these manipulations, flush away the contents in order to get a clear view of the extent of the cavity and carefully cut and scrape away the abscess wall and granulation tissue. Rub the parts over with iodoform emulsion and close the wound, leaving in a drainage tube for a day or two.

(2) *When there is Disease of the Rib Cartilage and Sternum.*—Adopt the same principles of treatment, but there will be more difficulty in removing the diseased bone, and if the sternum is affected the diseased bone will have to be cut away in small pieces with various shapes of bone forceps and chisels. It may not be possible to remove the whole diseased area, and in these cases it is best to leave the wound open to granulate.

H. S. PENDLEBURY.

NEW GROWTHS OF THE THORACIC WALL.

(1) **Of the Soft Parts Superficial to the Ribs.**—These are treated in the same way as are similar tumours in other parts of the body.

(2) **Of the Ribs.**—These may be :

(*a*) Simple, *e.g.*, osteoma, enchondroma.

(*b*) Malignant ; sarcoma, carcinoma.

Carcinomatous tumours are usually secondary to malignant disease of the breast, and it is generally wisest to leave them alone, especially if the skin is involved. Indeed any considerable involvement of the skin in a tumour of the rib, whether sarcoma or or carcinoma, is a distinct contra-indication to operation.

These operations should only be undertaken when a flap of skin can be raised and replaced after the growth has been removed. Permanent collapse of the lung is likely to result if the external wound cannot be closed completely. Usually the pleura will be excised extensively in removing the tumours, but in some cases of enchondroma this may be avoided.

Operation.—Turn up a flap of sufficient size to expose the entire extent of the tumour, and expose the ribs all round it at such places where they must be cut through. At each of these places remove ½ inch of the rib sub-periosteally before touching the pleura, thus leaving the tumour and the portion of ribs it involves attached only to the pleura and intercostal muscles. Incise the pleura and *slowly* produce a pneumothorax. When this is accomplished cut round the pleura and intercostal muscles, clip each vessel as it is cut across and remove the growth. If any adhesions to the deeper structures are found, cover the wound carefully with towels wrung out in hot saline, while these are dealt with. After ligaturing the vessels and stopping hæmorrhage close the wound with sutures as completely as possible and apply a large dressing. Preparations must be made to deal with the condition of shock which is produced by so severe an operation. If it has been possible to close the wound tightly and completely, treatment of the pneumothorax will not give rise to much difficulty.

H. S. PENDLEBURY.

DISEASES OF THE BRONCHI.

ASTHMA.

Before undertaking the systematic treatment of a case of asthma it is most essential that a thorough investigation should be made, not only of all the symptoms and physical signs presented by the patient and of the full history of the case, but in addition it is important that the family history should be carefully studied.

As is well known, cases of asthma can be divided into two groups: (1) Primary, idiopathic, or spasmodic asthma; and (2) bronchial asthma, where the asthma is associated with a bronchial catarrh, which has an important causative relation to the attacks.

It must be remembered that frequently recurring attacks of spasmodic asthma will set up a continued bronchial catarrh, so that often a case commences as true spasmodic asthma, but after a time the bronchial catarrh set up by the attacks becomes such an important factor that the case comes to be regarded as one of bronchial asthma.

The division of cases of asthma into the two above-mentioned groups is convenient, but it is quite an arbitrary division, and there is really no hard-and-fast distinction between the two types of cases. One may pass into the other, and in both the same etiological factors have to be considered.

Hay fever frequently presents typical symptoms of spasmodic asthma.

The treatment of asthma will be considered under three divisions: (1) Treatment when possible of the etiological factors of importance in the individual case; (2) treatment of the paroxysm; (3) treatment in the intervals of paroxysms.

Of course if a patient is seen during a paroxysm the immediate treatment will always be directed towards the relief of the distressing symptoms of the attack.

TREATMENT OF THE ETIOLOGICAL FACTORS.

Asthma has been truly described as one of the paroxysmal neuroses, and it is quite certain that in a large number of cases there will be found, after careful investigation, some exciting cause, the attack being the response to some reflex peripheral or central irritation.

The nervous symptoms of the individual and of his family must be carefully investigated, and associated conditions, such as migraine, epilepsy, mental disorders, etc., must be carefully enquired into. The relationship of worry, over-work and other exciting or depressing mental conditions to the attacks must be carefully considered. Also in the case of women the more frequent occurrence of paroxysms at the menstrual epochs or at the menopause must be borne in mind. Frequently in both sexes the nervous instability at the onset of puberty is responsible for an exacerbation of symptoms, and when this trying period is passed the attacks may become less frequent or even cease.

In every patient any exciting cause of irritation must be carefully sought for: thus the conditions of the naso-pharynx, abnormal conditions of the alimentary tract, the presence of gouty manifestations, the existence of increased arterial tension, and in women the presence of ovarian disorders must be carefully investigated.

In children special attention must in addition be paid to dentition, the presence of intestinal worms and other sources of irritation.

External exciting causes, such as exposure to a dust-laden atmosphere, the pollen of hay, changes of temperature or climate, or special smells or odours, etc., require attention.

Asthma sometimes occurs as a result of the depression following diseases such as influenza, pneumonia, pleurisy, bronchitis, whooping cough, measles, etc. And in tropical countries a definite association with malaria has been established in some cases.

In every case of asthma a careful investigation for the presence of renal disease should be made, and the urine should always be examined for the presence of albumin, casts, etc., and the efficiency of the kidneys measured by the daily excretion of urea, chlorides etc.

Asthmatic attacks may occur as a result of the circulating toxins occurring in kidney disease, the condition being known as uræmic asthma. This type of asthma requires treatment on the lines indicated under the article on Uræmia. The paroxysm will require special treatment on the lines indicated below; but it will be very important to avoid, if possible, the use of opium or morphia or its derivatives, owing to the profound and often harmful effects of these drugs on patients suffering from kidney disease.

The condition of the heart must always be carefully examined, for paroxysmal attacks of dyspnœa, sometimes called "cardiac asthma," occur as a result of cardiac disease. These conditions are not true asthma, and the treatment of them is described in the article on Heart Disease.

Diet.—A careful examination must be made of the stomach and alimentary tract for the presence of symptoms of dyspepsia, and, if possible, a relationship between the attacks with particular articles of diet, or with the taking of hearty meals at night, should be established.

The patient should be advised to have his chief meals early in the day, and late dinners or suppers should be avoided. The meals should consist of plain, nutritious food, and should be small in quantity. Over-distention of the stomach must be carefully guarded against. Indigestible articles of food and excess of starchy foods must be avoided. Coffee is usually more suitable than tea. In cases where the nutrition is poor, cod-liver oil or cod-liver oil and malt are beneficial.

If the attacks are associated with gout or high arterial tension, the special diet appropriate to these conditions chould be advised (*see* special articles on these subjects).

Any dyspeptic disorder must be treated by appropriate medicines, and if this seems to be an important causative factor, it may be advisable to have an examination made of the gastric contents after a test meal. The bowels must be carefully regulated, and any tendency to constipation must be overcome by the appropriate administration of saline aperients or some simple aperient medicine.

Climate.—No definite rules can be laid down as to the place most suitable as a residence for the asthmatic. The individual will probably soon discover for himself the places in which he is most free from attacks: often urban districts are more suitable than rural A change is always desirable where a patient is suffering from frequently recurring attacks. It will be wise at first for not too long journeys to be made. Generally a warm dry air is beneficial, but dusty atmospheres should be avoided. Some patients are benefited by residence at the sea, in such places as Hastings, Bournemouth, Folkestone, Cornwall, the Isle of Wight, etc.

Where there is severe bronchial catarrh, often a residence in a warmer climate during the period from December to May will be advantageous. Thus the Riviera, the Canaries, Biarritz or Pau, etc., may be visited. During the summer or autumn a course of treatment of the waters at Mont Dore is often of advantage, and in the summer the waters of Harrogate, Buxton or Woodhall Spa may be of benefit.

Morbid Conditions of the Naso-pharynx.—In every case of asthma the naso-pharynx requires most careful examination. The presence of any gross lesion, such as a nasal polypus or adhesions in the naso-pharynx, or abnormal conditions of the turbinal bones, or nasal septum, must be dealt with on surgical lines. In some cases there is a hypertrophied and congested condition of the turbinal mucosa, especially that over the middle turbinal bone. This condition should be treated by anæsthetising the affected area by the application of a plug of cotton-wool soaked in a 5 per cent. solution of cocaine hydrochloride for five minutes. The plug is removed, and afterwards the flat electric cautery, which has been heated to a dull red heat, is applied for a second or two to the parts in question.

In some cases where there is no gross recognisable lesion of the nasal cavities discovered, a hyper-sensitive condition of the mucous membrane of the nasal septum appears to be associated with the asthmatic attacks. In many of these cases relief has been obtained by cauterisation of the nasal septum as follows: A plug of cotton-wool soaked in 5 per cent. solution of cocaine hydrochloride is applied for five minutes to the portion of the septum which lies anterior to the middle turbinal bone. After removal of the plug the flat electric cautery, heated to a dull red heat, is placed for one second on the septum. It should be applied on a position about ¼ inch anterior to the part opposite the end of the middle turbinal bone. There is frequently at this spot a small tuberosity or cornu on the septum, and this is the ideal spot for the operation. Only one side of the septum must be treated at a sitting. The other side is treated similarly after three or four days, and then each side is alternately treated, allowing the same interval of time to elapse between each sitting. It may be necessary to cauterise about twelve times, but relief is in many cases experienced after three or four cauterisations. Many cases of asthma have had long periods of relief after this treatment, and some have been cured.

In children suffering from asthma, frequently the presence of adenoids and enlarged tonsils is responsible for the condition. The special appropriate surgical treatment should always be carried out in such cases.

In cases of asthma where there is no definite gross lesion discoverable as the cause, and where an excited and unstable condition of the nervous system is present, often the best results are obtained by rest, freedom from worry, a course of treatment with bromides, massage, electricity, etc.

TREATMENT OF THE PAROXYSMS.

The distress of an attack is so great that prompt relief should be given, if possible.

Morphine combined with atropin is one of the most certain remedies. The contra-indications are the presence of kidney or liver disease, or the presence of a considerable amount of bronchitis and bronchial secretion.

Morphine hydrochloride (gr. $\frac{1}{6}$), combined with atropine sulphate (gr. $\frac{1}{100}$), may be given hypodermically. In the case of children morphine should be avoided, or given only in very small doses. Some patients are excited by morphine, and with them the use of the drug should be avoided.

It is always wise to avoid telling the patient the remedy used if morphine is given, and the patient should never be allowed to give himself the injection for fear of the drug habit developing. If the attack does not subside after the administration of the small dose of morphia recommended above, this may be repeated in one hour.

In place of morphine, heroin hydrochloride (gr. $\frac{1}{6}$) may be given hypodermically. In some cases atropine sulphate (gr. $\frac{1}{100}$ hypodermically) is very effectual, also pilocarpine nitrate (in doses of gr. $\frac{1}{5}$ hypodermically) is a valuable drug.

The inhalation of amyl nitrite (5 minims) is often of value. The capsules are supplied surrounded with wool, and these may be broken and the vapour inhaled. The patient may keep these by him and use them if he finds he obtains relief. Often temporary relief can be obtained until the arrival of the doctor, who will be able to give a more powerful remedy. The vapour of chloroform (in capsules of 10 minims), spirits of ether (in capsules of 20 minims), or iodide of ethyl (in capsules of 5 minims), may be used by the patient instead of amyl nitrite, the latter often causing unpleasant symptoms. Pyridine (10 minims, in capsules) may be inhaled, but the unpleasant nauseating odour of this drug is a great drawback to its use.

Fumigations of various kinds are often of value in relieving a paroxysm. Most of these contain stramonium or belladonna, or plants of that group.

The following prescription is a useful example of this type of remedy: Stramonium Leaves, dried and powdered, ℥j; Lobelia, dried and powdered, ℥j; Black Tea, dried and powdered, ℥j; Potassium Nitrate, ℥j. These constituents are well mixed.

A teaspoonful of the powder should be ignited on a metal plate and the fumes inhaled. Stramonium cigarettes give relief in some cases. With some patients tobacco smoke is very beneficial.

Vapours.—The vapour from a steam-kettle containing medicaments such as cresol or tinct. benzoin. co., etc., often gives relief, or vapor benzoin. co. may be used.

The following is the prescription: ℞ Olei Eucalypti, ʒss; Olei Pini, ʒj; Tinct. Benzoin. Co., ad ℥j. One drachm of this should be added to 1 pint of hot water in a jug or inhaling apparatus and the vapour inhaled.

Oxygen often gives relief. The writer has obtained very good results in severe cases by the administration of oxygen bubbled in a rapid stream through a wash-bottle containing absolute alcohol. The alcohol vapour present with the oxygen relieves the spasm and stimulates the heart.

Chloral hydrate has often been found to give great relief. It should never, however, be given in severe cases where there is any sign of heart weakness. Doses of 10 gr. may be given every hour for three doses. Liquor trinitrini [U.S.P. spiritus glycerylis nitratis] may be given hypodermically in doses of 1 minim, repeated in half an hour if necessary.

Sprays of various kinds have been used extensively. The most effectual of these is one containing atropine and cocaine.

The following is a formula: ℞ Atropin. Sulphatis, gr. 1; Cocain. Hydrochloridi, gr. 2; Sodii Nitritis, gr. 10; Glycerini, ʒj; Aquam, ad ℥j. In the case of some sprays adrenalin solution is added.

The inhalation of these sprays must be given with a very fine atomiser or nebuliser, and often relief is given quickly if the spray is deeply inhaled through the nostrils and mouth.

The use of these sprays is not advisable, since while the symptoms of the attack may be relieved quickly, yet afterwards the mucous membrane is left in a more congested condition than before, and a fresh attack is likely to occur more quickly, so that the patient becomes soon a slave to his spray.

The hypodermic injection of adrenalin solution (in doses of 10 to 20 minims of the $\frac{1}{1000}$ solution of adrenalin chloride) has been recommended. It is not advisable to use this remedy, since there is danger of arterio-sclerosis developing.

Very frequently when one sees an asthmatic patient an attack is threatening, or the patient has recovered from the severity of the present attack, but is likely to have a recurrence after a short interval. In such cases it is always advisable to prescribe a mixture which will ward off immediate attacks. The following prescription will be found generally useful: ℞ Potass. Iodidi, gr. 3; Tinct. Stramonii, ♏10; Spt. Ætheris, ♏20; Ammon. Carb., gr. 3; Extract. Glycyrrh. Liq., ʒss; Syrupi, ʒss; Aq. Chloroformi, ad ℥j. [U.S.P. ℞. Potass. Iodidi, gr. 3: Tinct. Stramonii, ♏20; Spt. Ætheris, ♏20; Ammon. Carb., gr. 3; Fluid extract. Glycyrrhizæ, ʒss; Syrupi, ʒss; Aq. Chloroformi, ℥ss; Aquam, ad ℥j. To be taken every four hours.

In place of the tincture of stramonium, extract of stramonium (gr. $\frac{1}{3}$), or ethereal tincture of lobelia (♏10), or tincture of belladonna (♏8) [U.S.P. ♏10], or tincture of hyoscyamus (♏40) may be used in the above prescription. Stramonium is usually, however, found most effectual.

If heart failure is present or threatens it must be treated by the administration of cardiac tonics, such as strychnine, digitalis, convallaria, etc. Venesection or leeches are often of value where there is dilatation of the right heart.

In cases of asthma in a child a mixture such as the following will often be of value: ℞ Vin. Antimoniale, ♏8; Vin. Ipecac., ♏8; Pot. Iodid., gr. 2; Ammon. Carb., gr. 1; Syrup. Tolu., ʒss; Aquam Anethi, ad ʒij. [U.S.P. ℞ Vin. Antimonii, ♏8; Vin. Ipecac., ♏5; Pot. Iodid., gr. 2; Ammon. Carb., gr. 1; Syrup Tolu., ʒss; Aquam Anethi, ad ʒij.] To be taken three times a day.

Or an emetic of 3 drachms [U.S.P. 2 drachms] of ipecacuanha wine, or 20 gr. of powdered ipecacuanha, will often cut short an attack by causing vomiting.

TREATMENT IN THE INTERVALS OF THE PAROXYSMS.

In addition to the prophylactic measures indicated above, medicines should be given which will ward off recurring attacks. Arsenic is of great value, and this may with advantage be combined with potassium iodide, thus: ℞ Liq. Arsenicalis, ♏3; Potassii Iodidi, gr. 5; Syrup. Aurantii, ʒj; Aquam Chloroformi, ad ℥j. [U.S.P. ℞ Liq. Potassii Arsenitis, ♏3; Potassii Iodidi, gr. 5; Syrup. Aurantii, ℥j; Aq. Chloroformi, ℥ss; Aquam, ad ℥j.] To be taken three times a day after food. This should be taken for three weeks and omitted for two weeks. In some cases liquor strychninæ (♏3) [U.S.P. strychninæ hydrochlor., gr. $\frac{1}{36}$] given three times a day in a mixture is of value. Or a pill may be given twice daily as follows: ℞ Acid. Arseniosi, gr. $\frac{1}{20}$; Ext. Nucis Vom., gr. 1, in one pill. To be given twice daily after food. Caffeine citrate (gr. 5, in tablets twice daily) is often beneficial.

By careful treatment on these lines, and by careful attention to the prophylactic measures as indicated in the first part of this article, the period between attacks of asthma may be greatly lengthened, and in some cases the disease may be cured.

Vaccine Treatment.—In severe cases of asthma associated with persistent and marked bronchial catarrh it is always advisable to have the sputum carefully examined by a competent bacteriologist. For this purpose the sputum should be examined within two or three hours of its expectoration, since keeping it often leads to the causal organisms losing their vitality. Stained films of the sputum should be examined microscopically, and also cultures should be made on blood serum, serum agar and blood agar. In most cases the predominant organism is readily isolated. Frequently the microbe present will be found to be the diplococcus pneumoniæ or the bacillus septus. Other organisms, such as the Micrococcus catarrhalis, or Friedlander's bacillus, or the influenza bacillus will be found in some cases.

In cases such as these a vaccine should be made, and doses of 5,000,000 of dead bacteria should be given at intervals of four or five days. In many cases treated by the writer marked benefit has resulted when other remedies have failed.

Pneumatic Treatment of Asthma.—This is rarely applicable in the relief of the severe asthmatic paroxysms. In the intervals between the attacks the pneumatic treatment of inhalation of compressed air has in some cases been found beneficial. The compressed air baths relieve the emphysema associated with the asthma.

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BRONCHIECTASIS.

The main indications in the treatment of bronchiectasis appear to be to attend to the general health and nutrition of the patient, to empty the dilatations of the bronchi, to diminish the amount of catarrh and degree of fœtor, and to prevent the recurrence of the attacks of bronchitis.

While it is true that formerly the results of treatment were as a rule disappointing, within recent years a great advance has been made, especially through the employment of creosote baths and the postural method. The treatment should be carried out energetically; it is not enough merely to endeavour to allay symptoms as they arise. Treatment should be begun early, whether fœtor is present or not; an organised effort should be made to prevent the onset of decomposition of the contents of the cavities, and to ward off dangerous complications. Remedial measures should be perseveringly continued for a prolonged period—a period of a few weeks being quite insufficient to obtain the full effect of these therapeutic measures. A fundamental point would seem to be not to rely exclusively upon any one particular form of treatment, but to employ a combination of several. If such principles are carried out, a gratifying result may safely be anticipated in a large proportion of even the more advanced and chronic cases, while in early cases the results will be proportionately better.

When it is remembered that bronchiectasis is an exhausting disease, it will be clear that it is a matter of importance to promote and maintain the general health at the highest possible level. The patient should be given as liberal a supply of varied and nutritious food as he can assimilate; if the appetite is not good an effort should be made to improve it by the employment of mineral acids and bitters, or other remedies. Undue fatigue and depressing conditions of all kinds should be carefully guarded against. If anæmia is present it should be energetically treated. Prolonged courses of such tonics as iron, arsenic, quinine, the hypophosphites, cod-liver oil, and in children, the syrup of the iodide of iron, may with advantage be prescribed.

The importance of living in pure air is obvious for, among other beneficial effects, it diminishes the multiplication of bacteria; therefore, wherever possible, the patient should resort to a warm and equable climate, so that he may be in the open air most of his time. When the secretion is excessive in amount, as is often the case, a dry climate is to be preferred, such as that of South California, the tablelands of South Africa, or the high elevations of the West Indies. Where these are not practicable, the winter may be spent in Egypt or at one of the warm sheltered health-resorts along the Mediterranean coast; during the summer months a sheltered mountain-place of moderate elevation, especially among pine forests, such as is obtainable in some parts of the Black Forest, is preferable. The most suitable health-resorts in this country are probably those of the south coast, particularly Bournemouth.

In some instances the appropriate treatment will be directed towards the disease which caused the bronchial dilatation or in the course of which it has arisen. If there is reason to believe that the disease is due to syphilis, anti-syphilitic treatment may be given a trial.

Coming to special forms of treatment, if the writer were asked to choose one method alone, he would unhesitatingly choose that of **creosote baths.** This method, if points of detail are attended to and if the patient can be persuaded to exercise sufficient patience to give it a thorough trial, affords the most hopeful prospect of radical and permanent benefit. The following are the principal details of the method. Common commercial coal-tar creosote is to be preferred. A frequent mistake is to suppose that a special kind of chamber is necessary, whereas this is not so, for all that is required is a room which can be set apart for the purpose and cleared of furniture, indeed, even an outhouse may be sufficient. The chamber should preferably be situated some distance from the doors and windows of other buildings, as the odour of the drug is very penetrating. It should be about 7 feet square and 8 feet high, and be made as air-tight as possible by stopping up the chinks and holes in the walls with cotton-wool. About 5 or 6 oz. of the creosote should be poured into a fairly deep open metal dish, which is placed in the centre of the room on a ringed iron tripod, and under the dish a spirit-lamp with a regulating mechanism is introduced. A gas-jet, it may be remarked, is not advisable, as the supply-tubing may be set on fire. If the floor is of wood, it is well to put the tripod on a flat stone slab or in a large tinned vessel, in case the burning creosote should overflow the edges of the dish. The eyes should be protected by watch-glasses framed in sticking-plaster or surgical-strapping and tied with strings at the back of the head, or by a pair of well-fitting goggles, as used by Alpine climbers. The nostrils should be plugged with cotton-wool. An over-garment in the form of a smock frock or loose dressing-gown, and a bathing-bag or a towel pinned over the hair should be worn to prevent the retention of the scent of the drug. The spirit-lamp should be lighted and regulated so as to give only a gentle heat at first, in order that the percentage of vapour in the atmosphere be not great in the early stages of the treatment. The patient then enters the chamber and stays there from a few minutes to half an hour. As a rule it is better to enjoin that this treatment should be given only every other day during the early stages Later the heat, frequency and duration can be gradually increased until the exposure is from one to two hours daily, or in severe cases, even twice a day, and that in an atmosphere so dense with vapour that objects can be distinguished only with difficulty. When the patient can bear it, he may sit directly over the dish and inhale the vapour as it rises. The immediate effect is to excite severe paroxysms of coughing and the expulsion of large quantities of sputum; the residual phelgm is thus got rid of, and the drug may be assumed to get proportionately deeper into the tissues. The sittings should be continued for a long period, at least three or four months and possibly over six months; there should then be either bi-weekly sittings, or further courses of daily sittings alternating with intervals of several days of rest. It may be mentioned that this form of treatment can be safely used in children of six years of age or more.

The underlying idea of the **postural method of treatment** is to afford mechanical aid to the bronchial outflow. It may prove of the greatest value, and in the absence of any contra-indication should be put into practice in all cases. Patients themselves not infrequently observe that they are able to empty the dilatations most effectively by adopting certain postures; it largely depends upon the position of the dilatations. Enquiry should therefore first of all be made in regard to this. Among various ways of carrying out this treatment are the following. Periodically leaning well over the sides of the bed or table and placing the hands on the floor; adopting the genu-pectoral position; inversion; leaning down with the head low and a slight inclination away from the affected side; prone recumbency for one or two hours every morning and evening, or when the secretion has become scantier, in the morning only. At first the patient may be laid flat without any pillow, but later on the foot of the bed may be raised more and more every day until the castors are 14 inches or so above the floor. In all these positions the patients should be encouraged to cough and expectorate. Instead of the preceding intermittent method, the continuous method may be adopted. The foot of the bed should be raised by blocks, at least 10 inches high; a specially narrow and firm bolster secured at both ends to the head-rail, and no pillow, should be employed, so that the head and neck alone are raised above the level of the mattress. Children should be kept from lying across the bed by placing them between sand-bags. A fracture-bottom placed under the bed is very advisable, as otherwise, with a yielding foundation, the slant of the bedstead may be materially neutralised; and, if desired, by raising the foot of the fracture-bottom by slinging the foot-end on a rope fastened to the foot-posts or rails, and passing underneath through eyes or holes to prevent slipping, the castors can be dispensed with. During the day instead of lying in bed all the time the patient may sometimes lie on a tilted sofa. Supplementary treatment consists in exercises in the prone and slanting posture by means of the wheeled "convalescent machine," as supplied by Mr. John Ward, 246 Tottenham Court Road, W., in the case of adults, and of the "all-fours exerciser," as supplied by Mr. G. P. Turner, 16 Eccleston Street, S.W., in the case of children: the latter can be extemporised by padding a high stool, cutting down its legs to the extent required, and then mounting it upon wheels. By these methods the slanting position is constantly maintained either on the bed, sofa, machine, or exerciser. When the catarrh has subsided, while the nocturnal treatment is continued, the diurnal treatment may be made intermittent. During the whole time the respiratory jacket may be worn in the case of adults, or a costo-abdominal elastic belt, made of waterproof material, with buckles in front and at one or both sides an insertion of a lacing of indiarubber cord or tubing, in the case of children.

A third method of treatment is that of the **intra-tracheal injections** of suitable drugs. A frequent combination is menthol, 10 parts; guaiacol, 2 parts; and olive oil, 88 parts. Price's distilled glycerine may be substituted for the oil; the dose is 1 drachm at each sitting at first, gradually increased even up to 6 drachms, two or three times a day; a solution of izal in glycerine, dose, 1 to 3 oz., or a 2 to 10 per cent. emulsion of iodoform are other prescriptions. It is generally advisable to paint the throat with a solution of cocaine before giving the injection. The patient should sit upright in front of the operator, with the mouth on a slightly higher plane. To facilitate the gravitation of the fluid to the side desired, the mechanical chair designed by Dr. Colin Campbell, and supplied by Messrs. Baxendale & Co., of Manchester, may be employed, or the patient may recline on the side after the injection. At first the operator should employ tongue traction forwards and downwards, but after a little practice the patient can do this.

Until the operator has become accustomed to the variation in the angle which the epiglottis forms with the rima and the size of the latter, it is better for him to use a laryngeal mirror. The syringe should be all metal, with a capacity of 100 min., and should fit the curve of the base of the tongue, the nozzle being over 6 inches long; a good pattern is supplied by Messrs. W. Wood & Son, of Manchester. The nozzle of the syringe should be guided along the curve of the palate without touching it or the tongue, over the tip of the epiglottis, and, when seen to be below and behind this, should be passed rapidly into the larynx and pressed tightly against the base of the tongue, so as to fix the epiglottis and prevent spasm. The actual injection should be delivered with great rapidity, either with inspiration or during a slightly prolonged interval following expiration, the patient being directed to refrain from swallowing. This form of treatment is not advisable for children, and is frequently impracticable on nervous patients.

Among **other methods of treatment**, the following may be mentioned: Hypodermic injection of sterilised oil of guaiacol or of creosote, one part in four, each injection containing 30 min. Expectorants for three or four days and then an emetic, especially in the case of children. The internal administration of deodorising and antiseptic agents, such as creosote (1 to 3 min. in capsules or mixed with cod-liver oil thrice daily after meals), guaiacol (3 to 5 min. in capsules or 3 to 5 gr. of the carbonate in cachets), turpentine (5 to 10 min. of the oil in capsules or as an emulsion), terebene (5 to 10 min. in capsules or dropped on sugar or as an emulsion), myrtol (in capsules each containing 2 min., and two prescribed every two hours), ammoniacum, the balsams, copaiva, eucalyptol, tar, terpine, terpine hydrate, thymol and garlic in a sufficient dose and for a sufficient time to render the breath pungent with its odour. The inhalation of deodorising and antiseptic agents in the following ways: Vapour impregnated with the drug (one teaspoonful of oil of turpentine, or compound tincture of benzoin, or equal parts of creosote and spirit of chloroform directly inhaled with the vapour of hot water at a temperature of 140° F. from a jug or some other suitable vessel; or 20 to 30 min. of spirit of turpentine added from time to time to water in a bronchitic kettle); immersing cloths in 1 part of eucalyptus oil or pinol to 6 parts of rectified spirit, and then suspending them in the room; by means of a respirator, such as Burney Yeo's, Roberts's, Coghill's, or Curschmann's, the sponge of which is charged with about 10 drops of terebene, spirit of turpentine, eucalyptol, a mixture of equal parts of terebene, carbolic acid and spirit of chloroform, or creosote, or if irritation is present equal parts of creosote and spirit of chloroform, or if a still further sedative action is required, equal parts of creosote and ether or creosote and chloroform; by means of sprays, either steam, or through an atomiser or a nebuliser; by means of the "dry inhaler" bottle (the bottle containing a sponge or small pieces of blotting paper mixed with horsehair and steeped with the remedy through which air is drawn); by means of fumigation, such as of tar; or in children a two-fold piece of flannel soaked in an inhalant, and enclosed in an open bag of jaconnette, can be worn between the nightshirt and undervest, just below the collar, at night time. Continuous inhalation of oxygen for several hours daily from one of the bags invented by Dr. George Stoker for the purpose, is a method that may be tried. Sulphurous thermal waters, such as those of Harrogate and Mont Dore, are sometimes useful, as also are systematic respiratory gymnastics, systematic exercise of the thoracic and abdominal muscles, while manual compression to the chest and abdomen is recommended by Gerhardt. In all cases of bronchiectasis there is multiple infection. In some, and practically always in septic complications, such as septic broncho-pneumonia, there is a dominant micro-organism present; in these cases service may be rendered by vaccine treatment.

Surgical treatment is rarely advisable. It is indicated only when a single cavity exists, which can be located and is comparatively superficial, and where there is obliteration of the pleural cavity. It may be argued that in these circumstances it is not necessary, as other methods are usually sufficient. In all other cases it is contra-indicated; and under no circumstances should it be undertaken lightly, as there is considerable risk of hæmorrhage. If this method is employed free resection of the ribs and drainage of the cavity are necessary (*see also* Surgical Treatment of Bronchiectasis, p. 1061).

One of the main risks which the patient runs is that of recurrent bronchitis. He should, therefore, be most carefully instructed in prophylactic measures for all possible causes of cold, such as wearing insufficiently warm clothing.

FREDERICK W. PRICE.

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BRONCHITIS.

CATARRHAL inflammation of the large and medium-sized bronchial tubes is often present as a complication of such conditions as heart failure, pulmonary tuberculosis, typhoid fever, influenza, measles, whooping cough, asthma and malaria. In such diseases this complication may not require any separate treatment; but if the symptoms are sufficient to warrant special treatment, it will be on the lines discussed below. In such cases due consideration must naturally be paid to the primary condition; for example, bronchitis following upon heart failure will not be greatly relieved unless measures are taken at the same time to increase the power of the heart by appropriate treatment. Bronchitis, when separately considered, may for our present purposes be divided into (1) acute; (2) sub-acute; and (3) chronic bronchitis. Under the first group it is usual also to include what is called **capillary bronchitis.** Inflammation of the small or capillary tubes rarely occurs primarily, but may follow upon inflammation of the larger tubes, more especially in young children and old people. In the latter it is often known as acute asthenic bronchitis. In both children and old people the capillary inflammation merges insensibly into broncho-pneumonia. In fact, it may be argued that the treatment of capillary bronchitis would be best considered under the heading of broncho-pneumonia. The presence of inflammation in the smaller tubes greatly increases the probability of a fatal issue, and therefore requires prompt treatment, and especially free stimulation. In other respects the treatment is on the lines discussed below in connection with acute bronchitis. All forms of bronchitis, whether acute, sub-acute, or chronic, are due to the presence of one or more types of micro-organisms, such as Micrococcus catarrhalis, Streptococcus, Pneumococcus, Friedländer's bacillus, etc. Consequently in their treatment the question whether vaccine therapy is likely to be of avail has to be considered. Finally, the older authors were in the habit of dividing bronchitis into further groups, such as (1) pituitous catarrh or bronchorrhœa serosa; (2) bronchitis sicca; (3) putrid bronchitis; (4) plastic bronchitis. The first two of these divisions hardly represent separate entities, whilst putrid bronchitis is probably always associated with some degree of bronchiectasis.

ACUTE BRONCHITIS.

General Measures.—The patient should be confined to his bed, or at any rate to his room. He should not, however, lie down flat for long at a time, but should be well propped up by pillows. *The room* should be large or should have an open fireplace. Care should be taken that the air in the room is fresh, and frequently changed without exposing the patient to any sudden change of temperature. It is best to keep the room at an even temperature of 65° F. No gas or lamp contrivances which give off unwholesome products of combustion should be allowed, whether for lighting or heating purposes, as it is of the first importance to keep up a good supply of fresh air. If electric light is not available, candles should be used. *The bed* should be a small one to facilitate nursing, and should have a firm mattress. The bedclothing should be warm and light; eiderdowns, quilts, and feather beds are best avoided, as they often produce irritation owing to small particles of feathers being displaced, and so increase the tendency to cough. The bed should be fitted with light curtains, but the closed tents with a cover, which are so commonly used, interfere with the supply of the necessary air and increase the difficulty of respiration. The patient should wear a light, warm nightdress, which should open down its whole length to facilitate nursing and the application of poultices. The *air should be kept moist.* For this purpose a bronchitis kettle or an ordinary kettle with a couple of feet of metal tubing may be kept on the boil on the fire. A teaspoonful of the tincture of belladonna and of the compound tincture of benzoin may be added to the water in the kettle. In the acuter stages *poultices* give much relief. A large mustard and linseed poultice should be applied to the front of the chest, and when the skin is thoroughly red replaced by cotton-wool. A further poultice should then be applied to the back. The cotton-wool is best applied in the form of a jacket. Care must be taken that neither the poultices nor the jacket are allowed to interfere with the thoracic movements and so embarrass respiration. Neglect of this precaution, especially in weakly children and old people, may have serious consequences. Care must also be taken to see that the poultices are removed before they become cold. Many practitioners prefer the use of antiphlogistine, but the old-fashioned poultice is more useful if it is skilfully applied. *Sleep* should be encouraged, but the patient should be roused every two or three hours during the acuter stages, unless the respirations are free and regular, to encourage cough and facilitate expectoration. For this purpose alone it is necessary that anyone suffering from acute bronchitis should be constantly watched by a trustworthy person, as the bronchial secretions tend to accumulate during sleep and so to hinder the absorption of oxygen. It is often necessary that the patient on being roused should be given some stimulant, such as brandy and hot water, to aid him to expel the accumulated mucus.

Diet.—This should at first consist of warm fluids only; 2 pints of milk and 1 of broth daily in 5-oz. feeds every two hours. In gouty subjects peptonised farinaceous foods made with water should replace 1 pint of milk. Patients may be allowed to drink freely of warm, homemade lemonade diluted with Kali water. As the case progresses, oysters, farinaceous food and fish may be added to the diet. Care must be taken to avoid flatulence as far as possible, owing to the fact that its presence interferes with the movements of the diaphragm and so embarrasses the respiration further. *Stimulants* should not be given unless there is some special indication. If there is any sign of exhaustion, or of failure of the heart, or if the patient has difficulty in obtaining adequate sleep, carefully regulated doses of stimulants should be given. For this purpose brandy and hot water is the most useful form.

Medicinal Measures.—At the commencement of treatment calomel (gr. 5) should be prescribed, and may be followed in six hours by 1 drachm of effervescing sodium sulphate B.P. The bowels should be regulated daily. If the patient is fairly robust and is seen early in the attack, and the cough is harassing and unaccompanied by much expectoration, the following mixture is often of immense service: Antimon. Tart., gr. $\frac{1}{12}$; Liq. Morph. Tart., ♏10; Vin. Ipec., ♏10; Aq. Camphor., ad ℥j [U.S.P. Antim. Tart., gr. $\frac{1}{12}$; Morphinæ Tart., gr. $\frac{1}{11}$; Vin. Ipecac., ♏6; Aq. Camph., ʒij; Aquam ad ℥j], every three hours. This mixture should not be given for more than twenty-four hours. At the end of this time it may be replaced by: Pot. Citr., gr. 20; Liq. Ammon. Acet., ʒiv; Vin. Ipecac., ♏10; Aq. Chloroform., ad ℥j [U.S.P. Pot. Cit., gr. 20; Liq. Ammon. Acet., ʒiv; Vin. Ipecac., ♏6; Aq. Chloroformi, ℥ss; Aquam ad ℥j], every six hours; or if the expectoration is still very viscid: Ammon. Chlorid., gr. 10; Vin. Ipecac., ♏5; Syr. Tolu, ♏30; Mist. Ammoniaci, ʒij; Aq. Anisi, ad ℥j [U.S.P. Ammon. Chlorid., gr. 10; Vin. Ipecac., ♏3; Ammoniaci, gr. 4; Syr. Tolu., ♏30; Aq. Anisi, ad ℥j], every six hours. In cases in which there is much bronchial spasm, a few doses of apomorphin (gr. $\frac{1}{24}$), instead of the antimony, are sometimes of value. In old people ammonium carbonate is of service. *Oxygen* should be given from the commencement of treatment through warm water. This remedy does much to lessen the difficulty of respiration, and its use should not be confined to emergencies or the onset of marked lividity. If progress is satisfactory, the following may be substituted for the above mixtures: Pot. Iod., gr. 2 to 3; Vin. Ipecac., ♏5; Pot. Bicarb., gr. 15; Syr. Aurant., ♏30; Inf. Gent. Co., ad ℥j [U.S.P. Pot. Iodidi, gr. 2 to 3; Vin. Ipecac., ♏3; Pot. Bicarb., gr. 15; Syr. Aurantii, ♏30; Inf. Gent. Co., ad ℥j]; and when convalescence is established: Fer. et

Ammon. Cit., gr. 10; Pot. Iod., gr. 3; Pot. Bicarb., gr. 15; Inf. Gent. Co., ad ℥j, may be given twice a day. *Opium* is a dangerous remedy in bronchitis, and its use is hardly ever permissible when there is marked secretion, or in the case of young children or old people. If the cough is troublesome and the expectoration scanty, small doses of heroin are often of service. If this drug fails, ammonium bromide (gr. 10) may diminish the useless cough. If this fails, opium may be given; but the patient should be carefully watched and roused every two hours. *In the case of children*, when there is much difficulty in expectorating the phlegm, 1 drachm of ipecacuanha wine should be given every fifteen minutes until vomiting is established.

Threatened Heart Failure.—The patient and especially his extremities should be kept warm. The bowels should be well opened. Free stimulation with oxygen and brandy is necessary. Digitalis should be prescribed. If the stomach is not acting well it is best to give digitalin (gr. $\frac{1}{100}$ to $\frac{1}{30}$) hypodermically at such intervals as the clinical conditions may indicate. It is often of service to combine the digitalin with liq. strych. hydrochlor. (♏3 to 5); for, though strychnine may have no direct action on the heart, it probably stimulates the respiratory centres, and certainly patients are rendered more comfortable by its use. If the stomach is acting well the digitalin may be given in the following mixture: Tr. Digit., ♏10; Ammon. Carb., gr. 5; Syr. Tolu, ♏30; Aq. Camphor., ad ℥j [U.S.P. Tr. Digitalis, ♏30; Ammon. Carb., gr. 5; Syr. Tolu., ♏30; Aq. Camph., ʒij; Aquam ad ℥j], every four to six hours. In certain cases in which there is marked venous plethora, *venesection* to 10 or 15 oz. or the application of six to twelve leeches affords great relief.

Want of Sleep.—If the patient is becoming exhausted from want of sleep, probably paraldehyde in full doses (ʒj to ʒij), repeated in a few hours if necessary, is the safest drug. If it has no effect we may try heroin or trional, or we may give full doses of bromide in the form of an enema. When sleep is an urgent question the desirability of giving morphia must be anxiously considered. There are occasions when we have to decide whether the risk of exhaustion from continued want of sleep is not greater than the risks likely to follow the use of morphia. It is a mistake to wait too long, as if morphia is given when the end is inevitable, the fatal result is usually ascribed to the drug. When sleep is unattainable by other means, morphia (gr. $\frac{1}{4}$) often enables the patient to turn the corner; but when this drug or any preparation of opium is given, the patient must be carefully watched and roused from time to time, unless respiration is free and regular.

Vaccine Therapy.—As bronchitis is due to bacterial infection, and as there is a tendency for this condition to become more or less chronic, steps should be taken to ascertain what organism is the causal factor. Vaccination may be most useful in reducing the fever and alleviating the other symptoms during the acute stage, when other remedies are slow in their action. Further, it is probably wise to give patients a course of this form of treatment in order to raise their resistance to the organism, and so to render further attacks less probable (*see* under Chronic Bronchitis and Vaccine Therapy).

Convalescence.—Owing to the tendency in this disease to relapse, great care must be taken against exposure to sudden changes of temperature or to chill. After the patient is able to leave his bed he should keep to his room for some days. Later, care should be taken to avoid a chill in moving about the house, as exposure of the bronchial tubes at this stage to cold air certainly lowers the resistance of the local defensive forces, and enables the organisms to determine a relapse. A fine day should be chosen for the patient's first venture in the outside air. As soon as it may be safely permitted it is wise to prescribe a change of air to a mild climate, such as may be found in Bournemouth, Torquay or Falmouth. In view of the tendency to further attacks in subsequent years, every means should be taken to render the bronchial mucous membrane less susceptible to the invasion of micro-organisms. Vaccine therapy may help considerably in this direction, but there is no method more likely to accomplish this object than a *gradual acclimatisation to an open-air life* as soon as the patient's condition and the state of the weather render this permissible.

SUB-ACUTE BRONCHITIS.

When the catarrh is limited to the larger tubes and the temperature is not raised above 99° to 100° F., it is not necessary for the patient to go to bed. It is best, however, for him to be confined to his bedroom for a few days, and just as in the acuter forms of the disease, he should be careful not to expose himself to undue cold or sudden change of temperature. A hot bath at night and some brandy and hot water, together with 10 gr. of Dover's power, should be given at the onset. A mixture containing vin. ipecac. (♏10), liq. morphin. (♏5), mist. amymgdal., ad ℥j, may be given every six hours. If the patient insists on going out of the house, it is important to remember that the use of inhalations and sweating mixtures should be avoided, as they increase the susceptibility of the mucous membranes to the effects of cold. As the symptoms diminish, the above mixture may be changed for the following: Fer. et Ammon

Cit., gr. 10; Pot. Iod., gr. 3; Pot. Bicarb., gr. 15; Inf. Gent. Co., ad ℥j, twice daily twenty minutes after food. The same after-care as is mentioned under the heading of acute bronchitis is necessary if relapses are to be avoided; and what was said under that heading with regard to *vaccine therapy* applies with equal force to this condition.

CHRONIC BRONCHITIS.

The chief indications in this condition are: (1) The treatment of the cause of the disease apart from bacteriological considerations; (2) climatic treatment; and (3) vaccine treatment. If the determining cause is exposure to variations of temperature or to dust and irritating particles, the patient should, if possible, change his occupation, and, if necessary, his environment. If the condition is largely due to cardiac failure and long-continued congestion of the bronchial mucous membrane, the chief aim of treatment should be to strengthen the action of the heart (*see* Diseases of the Heart). If renal disease is the determining cause, the condition should be treated as one of mild uræmia. Gout is not infrequently to be met with in cases of chronic bronchitis. In such cases it is necessary that the general measures for the treatment of gout should receive adequate attention. If asthma or emphysema are present as complications, they should be treated on the lines laid down in the articles on these subjects. The condition of the nose and upper air-passages should always be investigated, as pathological conditions in these regions are a common cause of chronic bronchitis.

General Measures. — Persons suffering from chronic bronchitis require comparative freedom from work, and should be protected from exposure to sudden variations of weather or of temperature. For example, if a person suffering from chronic bronchitis is exposed, after sitting in a hot room, to the air of a cold bedroom, an exacerbation of his condition may result. This is sufficient to show that in many cases minute care has to be taken. In certain cases of chronic pulmonary tuberculosis it is not uncommon to find that frequent sub-acute attacks of bronchitis, and eventually chronic bronchitis, are set up in cold, and especially in damp, weather if open-air conditions are maintained. In such cases these attacks are prevented if the patient sleeps in a well-ventilated room with the windows shut. It is, however, true that open-air conditions will do much for the relief of chronic bronchitis. It is important that patients should only make the attempt to become acclimatised to these conditions during warm weather. Open-air conditions may then be possible also when colder or damper weather supervenes, and much may be done in this way to relieve the patient. If open-air conditions aggravate the discomfort, they must be given up; they are seldom of much service in the aged or in cases of great chronicity, in which the mucous membranes of the bronchi have undergone degenerative changes. In some instances, and especially when he is unable to afford better climatic conditions, the patient should be confined to the house or even to one room in cold and damp weather and after sunset. The main principle underlying this treatment is the endeavour to keep the temperature of the air to which the mucous membrane of the bronchial tubes are exposed as nearly as possible at the same level.

The *clothing* should receive attention. It should be warm and light. The garments worn next the skin should be capable of absorbing moisture and so preventing a "chill." Flannel, so commonly worn for this purpose, is insufficient; the best material is what is termed "cellular" clothing. Heavy clothes should be avoided, as they tend to make the patient perspire. The use of mufflers often increases the tendency "to catch cold," and should be avoided.

Diet.—This should be light, and consist chiefly of fish, tender mutton, chicken, game, eggs and farinaceous food in moderation. Flatulence and constipation should be carefully avoided. The chief meal should be in the middle of the day, and the evening meal should be a light one. If the digestion is imperfect or the patient easily tired, he should rest for an hour before luncheon and dinner. *Stimulants* should not be prescribed as a routine measure, and should be avoided unless there is a definite indication for them. If the cough is troublesome during the night, a little warm milk and rum is useful.

Climatic Treatment.—It is a great advantage to a patient suffering from chronic bronchitis if he can arrange to avoid the unsuitable climatic conditions of the winter in most parts of England. If the bronchitis is not associated with marked catarrh, a dry climate may be suitable; if catarrh is a marked feature, greater relief is obtained in places in which there is a fair amount of humidity, such as Falmouth. In all cases we should aim at a place where there is sufficient sunshine, a fairly equable temperature and sufficient shelter from wind. On the south coast, Falmouth, Torquay, Penzance, Sidmouth, Bournemouth, Hastings and Ventnor may be mentioned as suitable. So are Tenby, Colwyn Bay, Llandudno, and Southport. Malvern is a good example of an inland place. In Ireland, Rostrevor, Blarney, near Cork, and Glengariff have a good reputation. Abroad, Mentone, Hyères, Cap Martin, Madeira, Teneriffe, Southern California, Florida, the Azores, or the West Indies are suitable stations. In my opinion

Egypt should only be suggested to those who are fairly robust. In the summer Mont Dore, Ems and Royat are of service. If a patient spends the winter abroad he should not return to England before the end of May. Otherwise, he is apt to develop an attack of acute bronchitis, and so to throw away the improvement he has made during the winter.

Medicinal Treatment. — The bowels should be regularly opened. In many cases the use of blue pill and saline once a week is the only medicinal treatment required. In patients whose nutrition is unsatisfactory the use of small doses of cod-liver oil (ʒj to ʒij thrice daily) is sometimes invaluable. In many instances it is unwise to devote too much attention to the effect of various medicines upon the bronchial membranes. The use of these should be confined to a definite object, and their effect on digestion must be carefully noted, as it is of first-rate importance that the digestion and nutrition should be satisfactory. For most cases the most useful mixture is fer. et ammon. citr. (gr. 10), pot. iod. (gr. 3), pot. bicarb. (gr. 15), inf. gent. co., ad ℥j. If the cough is dry a decision must be made whether the cough is in excess or whether expectoration should be stimulated. In the former case we may give pot. iod. (gr. 3), pot. bicarb. (gr. 15), liq. morph. (♏10), aq. chloroform., ad ℥j [U.S.P. pot. iod. (gr. 3), pot. bicarb. (gr. 15), morph. hydrochlor. (gr. $\frac{1}{11}$), aq. chloroform. (℥ss); aquam, ad ℥j], three or four times a day, or glyco-heroin (ʒj); or a sedative linctus such as liq. morph. tartr. (♏3) [U.S.P. morph. tart. (gr. $\frac{1}{36}$)], acid. hydrocyan. dil. (♏1), oxymel. scill., ad ʒj. If lividity or drowsiness result, these sedatives must be withheld. If expectoration is to be stimulated, we may give ammon. carb. (gr. 4), tr. scillæ (♏20), inf. serpentariæ, ad ℥j [U.S.P. ammon. carb. (gr. 4), tinct. scillæ (♏40), inf. serpentariæ, ad ℥j], four times daily; or, if gout is a marked feature, potassii iodidi (gr. 3), pot. bicarb. (gr. 15), ammon. carb. (gr. 4), aq. camphor., ad ℥j [U.S.P. potassii iodidi (gr. 3), pot. bicarb. (gr. 15), ammon. carb. (gr. 4), aq. camph. (ʒij), aquam, ad ℥j], thrice daily. If expectoration is profuse, morphia and other sedatives should be avoided. Tar is useful in such cases, and the following may be given: Liq. Picis Aromat., ♏20; Syr. Pruni Virg., ♏30; Syr. Codein. ♏30; Inf. Cascarill. ad ℥ss [U.S.P. Liq. Picis Aromat., ♏20; Syr. Pruni Virg., ♏30; Codein. Phosph., gr. $\frac{1}{8}$; Inf. Cascarillæ, ad ℥ss], thrice daily. In chronic bronchitis of the aged, ammonium chloride (in 5-gr. doses) may be included in the prescriptions, its taste being suitably disguised. If an attack of acute bronchitis supervenes, treatment should be on the lines detailed under that heading.

Vaccine Treatment.—Bronchitis is due to the lowering of the resistance of the bronchial mucous membrane from various causes and the invasion of various micro-organisms. Part of our treatment must necessarily be directed against these organisms, and the most useful form of treatment devised so far is vaccine therapy. The organisms most commonly met with are the Micrococcus catarrhalis, Pneumococcus, Streptococcus, Pfeiffer's bacillus and Friedländer's bacillus. Many other organisms are occasionally found, and in bronchitis associated with typhoid fever, diphtheria, etc., the organism of the primary disease is usually present. The sputum should be examined and the organism or organisms present cultivated. If only one is present, a vaccine should be prepared and used on the lines laid down in the article on Vaccine Therapy. If more than one organism is cultivated, it is sometimes difficult to determine which is responsible for the bronchitis, or whether more than one is. Sometimes the determination of the resistance of the blood, as shown by the opsonic index, to the various organisms present may give us the necessary information. Failing this, it may be that one organism is present in large quantities and the others in small. In such a case it is wise to use, at any rate in the first place, the organism present in large quantities. In other cases the history of the case may be of service. If a patient has recently had a well-marked attack of influenza and the corresponding bacillus was then isolated, it is probable that a complication in the shape of bronchitis is due to this micro-organism, even if others are present. In some instances other cases in the same house may be associated with only one organism, and this fact may help us to decide on the vaccine to use. For example, the sputum of a man suffering from bronchitis contained streptococci and numerous other bacteria. The sputum of his son, who was also suffering from bronchitis, contained only streptococci. A vaccine of the latter gave good results in both cases. In yet other instances a trial of different vaccines may have to be made to ascertain which is the essential one. In all cases a vaccine prepared from the patient's own strain should be used, as it has much more effect than a stock vaccine.

For the details of this treatment the reader is referred to the article on Vaccine Therapy in Volume III. In many instances it gives excellent results, in others it affords some relief, but in some it apparently fails altogether. It never does harm if care is exercised. If, on the other hand, too large doses are given or the treatment is given by one not thoroughly conversant with its limitations, harm may and often does result. I have seen two fatal cases of bronchitis in which, to the best of my judgment, the fatal issue was directly due to the incompetent application of vaccine therapy and the use of enormous doses. If the results of treatment are immediately satisfactory it must not be thought that the patient is to be free in the future from all attacks of bronchitis. The immunity conferred is higher than what was previously present, but unfortunately it is not by any means necessarily permanent. Vaccine therapy in this disease occasionally raises the immunity to such a degree that the patient is free for years; in most cases the period of immunity, although greater than what the patient has previously experienced, may be a matter of months rather than years. When a further attack of bronchitis comes, vaccine therapy should again be used, not only for the immediate purposes of the attack, but to develop a further immunity against relapse. In some instances it is undoubtedly wise to give further courses of the vaccine every six months for a time, even if no attack supervene.

PECULIAR FORMS OF BRONCHITIS.

In **Pituitous Catarrh or Bronchorrhœa Serosa** relief is sometimes obtained by the use of prescriptions containing turpentine, copaiba, or the balsam of Peru or of tolu. The following prescription are given by Dr. Burney Yeo: Copaibæ, ♏20; Mucil. Acac., ʒj; Sp. Chloroform., ♏5; Aq. Camphor., ad ℥j, thrice daily; or Olei Terebinth., ♏5; Mucil. Acac., ʒiv; Mist. Amygdal., ad ℥j [U.S.P. Copaiba, ♏20; Mucil. Acac., ʒj; Sp. Chloroform., ♏5; Aq. Camph. ʒii; Aquam, ad ℥i; or Terebinth., ♏5; Mucil. Acac., ʒiv; Emulsum Amygdal., ad ℥j], thrice daily. In **Bronchitis sicca** the most useful drug is ammonium chloride, but it must be pushed until it produces some result. In **Putrid bronchitis** the treatment is the same as that of bronchiectasis. Continuous inhalation of equal parts of sp. chloroformi and creosote through a perforated zinc inhaler often gives great relief. In some cases in which there is no evidence of bronchiectasis the sputum, although scanty, is most offensive. Such cases are always associated with some micro-organism. I have seen these cases, in which ordinary treatment had failed, yield, so far as the offensive character of the expectoration was concerned, almost at once to the use of autogenous vaccines. **Plastic bronchitis** is not benefited much by treatment. The use of a steam kettle to warm the air, and if dyspnœa is urgent during the expectoration of a cast, an emetic, may be of assistance. In some cases potassium iodide may diminish the frequency of the attacks. It was hoped that vaccine therapy might be of service in this distressing condition. In two cases under my care streptococci have been the only organisms present in the casts, but in neither case did vaccine therapy yield a satisfactory result.

ARTHUR LATHAM.

DISEASES OF THE LUNGS.

ABSCESS OF THE LUNG.

In not a few cases small abscesses heal spontaneously after evacuation by expectoration, no treatment being necessary. More commonly, however, the evacuation is incomplete, fever and expectoration continue and active measures are called for.

Little can be expected from drugs exhibited by the mouth. If creosote is tried, a considerable dose should be given, a convenient form being creosote and alcohol (āā part æq., 10 to 20 drops or more in milk t.d.). Intra-tracheal injections are likely to be more effective, but require experience, and are not agreeable to the patient, *e.g.*, guaiacol, 2 parts; menthol, 10 parts; olive oil, 88 parts. The dose for injection is ʒj, a special syringe being used.

The writer has found treatment by a vaccine of great value, though in the more serious cases this method should be employed only as an adjunct to drainage (*see* Vaccine Therapy, Vol. III.).

J. J. PERKINS.

SURGICAL TREATMENT OF ABSCESS OF THE LUNG.

Abscess of the Lung following Pneumonia.—Abscesses of the lung following pneumonia may be single or multiple and are not infrequently accompanied by gangrene. They may burst into a bronchus and be coughed up. If this is the case the patient may be left alone for a few days to see whether any improvement is occurring. In the absence of improvement the abscess should be treated surgically.

Localisation of these abscesses is extremely difficult, and after the diagnosis has been made by the physician and the position of the abscess defined as accurately as possible, the surgeon should try to find pus by means of an aspirator. Never proceed to incision of the lung until the presence of an abscess has been actually ascertained by aspiration. All preparations are made for resection of a rib, incision of the lung and drainage of the abscess; the patient is placed on the operating table either with the affected side overlapping the edge of the table or lying entirely on the affected side as for empyema. During the process of exploration by the aspirating needle no anæsthetic should be given.

A number of punctures may be required before pus is found. If pus is found only allow a few drops to run away, and leave the needle in position, taking every precaution to prevent its being displaced while the patient is partially anæsthetised. (For the choice of anæsthetic *see* Vol. III.) Excise about 2 inches of the two ribs, one above and one below the needle, ascertain whether the parietal and visceral pleura are adherent; this is often the case, and if it is so the lung can be incised alongside the needle. If it is not so, before opening the pleura carefully stitch the parietal and visceral pleura together along the margin of the wound with catgut threaded on curved needles, and make sure that the lung substance is pierced through to a fair depth and that a good area is left for further operative manipulation. Incise cautiously alongside the needle until the lung is reached, then pass in a pair of sinus forceps until pus flows out. The needle is withdrawn and, by slightly separating the blade of the forceps, the pus is allowed to flow out slowly. When most of the pus has escaped the blades of the forceps are separated still more and the opening in the lung enlarged so as to admit the finger for further exploration of the cavity. Do not wash out the cavity; such a procedure may result in filling the bronchi with fluid and death from drowning. If possible, dust the walls of the cavity with a little iodoform through an insufflator and then introduce and suture to the skin a large drainage tube with no lateral holes but with a semicircular piece cut out of the end as in empyema. This tube should be quite as large as the hole in the lung tissue made by the finger. Do not stitch up the wound but apply a voluminous dressing. The tube is left in until the third day, when it is removed for cleansing purposes, and replaced daily until the discharge has ceased. Every other day a little iodoform powder may be blown into the cavity. In these cases there is always grave danger of infecting the pleural cavity and causing an empyema.

The general condition of the patient after pneumonia, the possibility of gangrene of the lung, the fact that more than one lung may be affected, and that there may be more than one abscess present in the lung, make the prognosis of these cases very unfavourable. A favourable issue can only be expected when the abscess is single and confined to one lung, and its presence is quickly diagnosed.

The actual surgical treament of cavities in the lung of long standing, whether bronchiectatic, tuberculous or non-tuberculous, is on the lines described above for pulmonary abscess.

Bronchiectatic cavities often communicate with each other, and it is difficult to reach one of them at a spot suitable for drainage, and even if this is attained it does not ensure that the other cavities will drain adequately through the same opening. As a rule, surgical interference will only give good results where there is one large cavity. In these cases the parietal and visceral pleura are seldom adherent, and great care must be taken to suture the two layers before the pleural cavity is opened.

The surgical treatment of tuberculous cavities has not been very successful so far. If small they are more likely to derive benefit from medical treatment, and if large the patient's condition is often too precarious to allow of operative measures being undertaken.

Non-tuberculous cavities, such as those produced by rupture of liver abscess into the lung, are more amenable to surgical treatment, and on the whole the results are much more favourable.

Abscess due to Foreign Bodies in the Bronchus.—Impaction of a foreign body in one of the smaller bronchi in the lung substance may cause pneumonia with abscess of the lung or localised empyema.

A skiagram should be taken in all cases where a foreign body is suspected, for if the foreign body gives a shadow with X-rays great assistance will be given to its accurate localisation.

Exploration for the foreign body, whether an abscess has or has not resulted, should be carried out as above described for abscess of the lung.

If an empyema has been produced the surgeon will probably find after opening it that the finger passes into a cavity in which the external surface of the lung is ragged, and careful examination with the finger and probe may discover a sinus leading into the lung tissue or even feel the foreign body. If the latter, it can probably be removed with suitable forceps.

If the foreign body is not discovered free drainage should be provided, for in some cases it may find its way out along this track.

As a rule, the patient's condition rapidly improves, but ultimate healing is uncertain and a small sinus may persist.

H. S. PENDLEBURY.

ATELECTASIS AND COLLAPSE OF THE LUNGS.

By *atelectasis* is understood a condition in which the lung remains in the fœtal condition, that is to say, it never expands. In *collapse* the lung returns to a state of non-expansion. Collapse may occur at any period of life, but it never reaches such an extreme degree as when air has never entered the lung. Anything which prevents the expansion of a lung, either in whole or in part, will lead to collapse of the parts hampered; the treatment, then, will consist in attempting to prevent those causes likely to lead to collapse, or in taking measures to remove them when present.

ATELECTASIS.

This condition occurs in the new-born either as a result of the child being born in an excessively feeble state, perhaps prematurely, or owing to some mechanical impediment preventing the air from entering the lungs; also, the same want of expansion takes place when the utero-placental circulation is injuriously interfered with. The arrest of this circulation induces attempts at inspiration which are fruitless. In most cases when the child is born in a state of apparent asphyxia its face is swollen and of a dark livid colour. Attempts should of course be immediately made to excite respiration. The cord should be at once tied, and if the face is very livid, a few drops of blood may with advantage be allowed to flow from the cord before this is done, with the object of relieving the embarrassed circulation. Some slight stimulus, such as one or two sharp slaps on the thorax, or the old plan of rubbing the body with brandy poured into the palm of the hand, will often suffice to induce respiration. Failing this, the sudden and alternate application of heat and cold may be tried; this can be carried out by dipping the child for a single moment into hot water, and then into cold, and these alternate applications may be repeated once or twice as occasion requires.

If these measures are without success, artificial respiration must be resorted to. Other means of exciting respiration have also been adopted, such as inflation. On the Continent this is performed by means of a flexible catheter guided into the glottis. It is claimed that this method allows the liquor amnii and other fluids which may have been drawn into the lungs in the premature efforts at respiration before birth to be sucked up into the catheter and so removed from the lungs. The plan of placing the hand over the nostrils of the child, blowing into its mouth and immediately afterwards compressing the thorax is not so satisfactory, as most of the air enters the œsophagus and not the larynx.

COLLAPSE OF THE LUNGS.

As already stated, the treatment of collapse must vary with that of the diseases in connection with which it originates. It must also be borne in mind that the collapse results mainly from two conditions, obstruction of the bronchi and defective inspiratory power. Efforts must therefore be directed to remove the first and to remedy the second.

When the obstruction is organic and is situated in the upper air-passages, if collapse occurs to any serious degree, tracheotomy should be at once performed. Such extreme measures, however, are but rarely required. It may here be mentioned that Dr. W. Pasteur has drawn attention to the occurrence of extensive collapse of the lung in children suffering from diphtheritic paralysis, in which death occurs from paralysis of the diaphragm; cardiac failure is likely to ensue, which must be treated by the usual remedies, the subcutaneous injection of strychnine probably yielding the best result.

Bronchitis is most likely to cause collapse in children who have been rendered weak by improper feeding, bad hygienic surroundings and congenital syphilis; rickets is likely to ensue and soften the bony thorax, and thus favour the occurrence of collapse. Indications of debility should therefore always be sought for in children suffering from bronchitis and the appropriate treatment adopted. If tough mucus collects in the bronchial tubes, or if there is, on the other hand, excessive secretion, impending collapse may be averted by an emetic of mustard and water, or five grains of powdered ipecacuhana may be administered. Expectoration may be assisted in the early stages by alkalies, such as bicarbonate of potash or soda with iodide of potassium, and when secretion is more abundant by stimulating. expectorants, such as carbonate of ammonium or some preparation of squill.

Stimulating liniments may be applied to the chest, but the writer does not favour enclosing the chest in layers of cotton-wool, as is so often the practice. The chest must be given every facility for expansion; the clothing, therefore, should be warm, but loosely applied, a thin wool jacket being the most suitable. These remarks especially apply to febrile cases. If the temperature of the body is high, radiation of heat should be encouraged, and yet how often is the chest encased in a " jacket poultice," so hampering the loss of heat by natural means, *i.e.*, radiation.

When coldness and lividity of the surface occur a warm bath may be employed, but it should not be prolonged. The vital and muscular power must be maintained in every way. Stimulants are frequently requisite and must be given in adequate and repeated doses.

An abundant supply of fresh, pure air must be assured, but the plan formerly adopted of keeping the patient in a close atmosphere saturated with moisture has been largely abandoned.

Dr. W. Pasteur, in the Bradshaw Lecture for 1908, drew attention to the active collapse of the lung caused by paralysis of the muscles which are the direct distenders of the lungs, the diaphragm and the intercostal muscles. Artificial respiration has been found to be of value in this condition, and oxygen gas will also be found of assistance.

Collapse of the lung may occur in connection with pleuritic effusion, leaving one side of the chest contracted. Regulated gymnastic exercises are of great value in correcting the contraction. Such exercises must be supervised, as there is frequently a tendency to carry the treatment to excess, so bringing an unnecessary strain upon the heart.

FRANK J. WETHERED.

BRONCHO-PNEUMONIA.

Broncho- or Lobular Pneumonia occurs at all ages, but the majority of cases occur in children under four years of age and in debilitated adults. The infection is due to an organism, usually a pneumococcus, streptococcus, staphylococcus, Friedlander's bacillus or B. coli, singly or in combination, and less commonly to some other organism, such as the B. typhosus. The mode of infection is, as a rule, by direct spread from the larger bronchi or bronchioles. This spread indicates that there is a marked depression of immunity, and explains the serious nature of this disease. The duration of the disease is from two to eight weeks or more. The mortality is high, reaching in infants 30 to 60 per cent. **Septic pneumonia** is a variety of broncho-pneumonia, in which septic or infected particles, as distinguished from septic organisms, are inhaled usually from the mouth or œsophagus.

General Management.—The patient should be put to bed at once. The room should for preference have a southerly aspect; the bed (which ought to be a single bed) must be so placed as not to be in the direct line of draught, *i.e.*, not between the window and the door, and should be drawn a foot or 18 inches from the wall in order to avoid any down-draught. If this cannot be arranged satisfactorily a tent should be constructed. A fire should be lighted even in summer in order to aid ventilation, for it is essential that the patient should have an abundant supply of pure air. Further, it is better that the air should come from outside the house rather than from a passage, even though windows are open in the latter. Much care and ingenuity are required to obtain a good supply of fresh air, and at the same time to keep the room at the suitable temperature, viz., 60° to 65° F. The atmosphere around the patient must be moist to prevent unnecessary coughing. For this purpose a kettle with a long spout discharging steam into the room should be constantly on the hob. Where the outside air is moist the kettle may be dispensed with or only used at intervals. Whenever possible, two nurses, one for day and the other for night duty, should be obtained. The usual nightdress should be supplemented by a cotton-wool jacket. Arrangements must be made at the commencement of the illness for a continuous supply of the latter, for they will have to be dried and changed frequently, especially if the patient perspires readily.

At the commencement of the attack linseed meal *poultices* are of much value. The first may contain some mustard. The quantity of linseed meal for the poultice should be measured out and placed in the bowl. A small teaspoonful of mustard should be lightly sifted on to it, and the poultice then made in the usual manner. It should not be left on longer than causes the patient some discomfort. For children they must be made very light. The poultice should be changed every two hours; and, since all the good done by the poultice is negatived if the part treated is exposed or gets chilled during the act of changing, it is obvious that this treatment should only be adopted where the nursing is of a high standard. If such efficiency is not obtainable, it is better to use other means. For example, the affected part may be rubbed with some stimulating liniment such as linimentum terebinthinæ, or the same liniment may be applied on lint. Anodynes are not indicated at this stage, for there is, as a rule, no pleurisy causing pain, but they are useful later when the muscles become tender from prolonged coughing. It is essential that the local applications should not hinder respiration; therefore only a small area of the chest should be poulticed at one time. Thus the whole back may safely be poulticed if the patient will lie on the back or in the recumbent posture, as no weight is placed on the chest, but it is not expedient to cover the whole of the front of the chest, for the respiration is then apt to become embarrassed. Similarly, much consideration should be given before poulticing the front of the apices of the lungs, though this is not frequently required. In case of doubt it is better to omit this form of application. Ice to the chest is not to be recommended in this affection.

A few details may be given regarding the use of the *steam kettle*. Its object is to warm and moisten the air. It is undoubtedly depressing if continued for too long a period, and is harmful if there is much sweating or the expectoration is decidedly liquid. The kettle is indicated where the air is dry, when the larynx, trachea or bronchi are affected, and there is an irritable unproductive cough. It is of special value therefore at the onset. Tinct. benz. co. 1 drachm may be added to a pint of water in the kettle. There should be intervals of one hour on and one hour off. The kettle should be so arranged as not to discharge steam on to the face, and should be at such a distance that the nozzle cannot be touched by the patient. The distress of the child is increased when the kettle is discharging steam continually into a tent at a distance of 2 feet or so from the face, for the steam condenses on the head and runs down on to the clothes. Burns on the hands are also distressing to everyone concerned.

The patient may be allowed to assume the most comfortable position in bed. It is however advisable to see that the posture is changed at intervals of a few hours.

The Diet.—This is of great importance, for distension of the stomach tends to produce embarrassment of respiration. It is impossible to lay down a diet which will be suitable to patients of all ages, but it should be one which will be easily digestible and not give rise to flatulence. It is a good rule to order a liquid diet consisting of milk freely diluted with water, or water to which sodium citrate (in the proportion of 1½ gr. to 1 oz. of milk) has been added. The quantity allowed at each meal should be somewhat reduced as compared with that usually taken. Where diarrhœa is present or there is a tendency to vomit it is best to give white wine whey, or albumin water, to which sugar and cream may be added in small quantities when the diarrhœa has lessened. In the elderly the diet must not be so much restricted, but large amounts of carbohydrates are especially to be avoided. Eggs, meat juice, beef-tea, jelly, etc., may be substituted to some extent. Natural lemonade, sweetened or not, is useful to relieve thirst, and may be given freely at all ages. It replaces the liquid lost by sweating, and has also an expectorant effect. The first liquid taken in the morning should contain an alkali, such as soda bicarbonate, in the strength of 20 gr. to 10 oz. of liquid. It may be given either in water or milk, which should be warm.

Alcohol is a valuable stimulant, and should, if prescribed, be taken at regular intervals. In the early stage, it should be given when general collapse is present. Brandy may be ordered for young children in 10 min. doses with 2 drachms of water. In adults who have been accustomed to take a certain amount of alcohol in any form there is danger in eliminating it entirely from the dietary, or even in reducing the total quantity, provided the latter is not considered to be excessive.

Drugs.—At the commencement of the illness a purgative should always be given. Calomel (½ gr. for a child) or grey powder (1 or 2 gr. doses) is most serviceable. In adults a corresponding dose of calomel or blue pill will produce a better result than the more ordinary purgatives. Of drugs, the alkalies, potassium nitrate, ammonium acetate and ammonium carbonate, are of value, especially when bronchitis is present. The dose must be varied according to the age of the patient. Vinum ipecac. in 5 min. [U.S.P.

3 min.] doses may be added to the above, the mixture being given four-hourly. If the type of breathing suggests bronchial spasm, belladonna or stramonium should be used. Digitalis or strophanthus should also be given when the heart is rapid and cardiac failure is threatened (as indicated by cyanosis, sweating, displacement of the apex beat to the left and increased cardiac dulness to the right). Indeed, it is a good plan to add some digitalis to the mixture from the commencement, as cardiac dilatation is a complication frequently met with in these cases. Digitalis should not be given to patients over the age of sixty, but bleeding from a vein or leeching may be substituted when necessary.

Such a prescription for a child of two years would be: ℞. Liq. Ammon. Acetat., ♏15; Inf. Digit., ♏10; Sp. Ammon. Aromat., ♏5; Tr. Bellad., ♏2½; Syrup, q.s.; Aquam, ad ʒij; ʒij every four hours. For an adult: ℞. Ammon. Carb., gr. 7½; Liq. Ammon. Acetat., ʒj; Tr. Stramon., ♏5; Vin. Ipecac., ♏10; Sp. Vin. Rect., ♏20; Syr. Limonis, q.s.; Aquam, ad ℥j; [U.S.P. ℞. Ammon. Carb., gr. 7½; Liq. Ammon. Acetat., ʒj; Tr. Stramonii, ♏10; Vin Ipecac., ♏6; Alcohol., ♏20; Syr. Acid. Citrici, q.s.; Aquam, ad ℥j]. ℥j every four hours, ex aq. ℥iij. Where the patient is restless and the cough is dry, a small dose of Dover's powder (½ to 1 gr. for a child, 10 to 20 gr. for an adult) may safely be given at night. It should not be given where there is much secretion in the bronchial tubes.

Sleep is of great importance in all these patients; everything should therefore be done to secure good nights throughout the illness and especially at the commencement. With this object the bed must be made comfortable, the room must be kept quiet, and the patient should be shaded from any light which it may be necessary to keep burning. A small dose of potassium or sodium bromide (2½ gr. for a child or 15 gr. for an adult) may be given about nine o'clock.

Special Symptoms in the Early Stages which require attention are convulsions, collapse and unproductive cough. Convulsions should be treated by purgatives combined with hot baths, of not more than five minutes duration each. Collapse should be combated by hot bottles and hypodermic injections of strychnine, $\frac{1}{200}$ gr. for a small child. The unproductive cough may be diminished by the steam kettle, demulcent drinks, such as lemonade and barley water, and by the administration of Dover's powder. The writer is not in favour at this stage of the illness of the administration of aconite, tartar emetic, or of the application of ice to the chest wall.

The Treatment in the Later Stages must necessarily undergo some modification. Poultices and the steam kettle should be discarded as soon as it appears that no improvement follows their use, but the general directions given above for ventilation, diet and medicine should be continued. New symptoms may arise and give cause for anxiety. Refusal to take food is one of the commonest. As the illness is one of considerable duration it is most important that this should be combated at once. It is inexpedient to allow the patient to miss more than one feed, and if persuasive means are of no avail the nasal tube should immediately be resorted to.

Great gentleness should be observed in passing the tube. In default of a nasal tube a soft rubber catheter, size 6, may be used for a child. Abdominal distension is of frequent occurrence and should be treated by the administration of castor oil in teaspoonful doses, while at the same time whey or albumin water should be substituted for milk, beef-tea, Benger, etc. Oleum cajuputi or turpentine on sugar helps to get rid of flatus. Calomel in doses $\frac{1}{40}$ or $\frac{1}{20}$ gr., after each feed, helps also to keep this in check. Diarrhœa and vomiting, if excessive, are best treated by washing out the rectum or stomach and by revising the diet on the lines given above. Small doses of Dover's powder or bismuth may also be given. Collapse should be guarded against by the early and regular use of injections of strychnine and ether. If cardiac dilatation threatens, bleeding is advantageous in adults, but in children leeching over the liver is more practicable and effective. A mustard leaf applied over the pericardium will frequently improve the circulatory trouble. When these means do not relieve the symptoms pointing to collapse—a rapid pulse, sweating, shallow breathing, diminished cough, pallor or cyanosis—a good effect may sometimes be produced by the subcutaneous injection of normal saline. For this purpose the salt solution should be made of half the usual strength, and 10 min. of 1 in 1,000 adrenalin chloride may be added to the $\frac{1}{2}$ pint. The injection is best given in the subcutaneous tissue of the axilla through one or more needles, and if improvement follows may be repeated every twelve hours. Where the chest wall is weak and yielding gentle pressure to aid in expiration will be beneficial, as will also the application of a flannel binder as an abdominal support. This is especially serviceable in those children in whom the abdominal wall is very flaccid. The patient should not be prevented holding the side of the bed or some other structure, thereby aiding the external muscles of respiration. Inhalation of oxygen, though theoretically of great importance, is practically of little use. It is usually begun too late and then as a placebo to the relatives, but if administered the gas should be bubbled through hot water in a Wolff's bottle and the discharging funnel apparatus should be fixed at a distance of a foot or more from the patient's face. The gas should not be allowed to escape so fast as to produce a hissing noise, as this is distinctly irritating. A better effect is produced by bubbling the gas over alcohol, as recently suggested by Dr. Willcox. Prolonged hyperpyrexia is infrequent; if present it should be treated by sponging with water at 90° to 95° F. A persistent nasal discharge may occur during this stage of the illness; it should be treated by an alkaline nasal douche, varying in frequency according to the amount present. Small doses of bromide may be given at night to produce sleep.

When much expectoration is present the patient should be awakened at regular intervals and coughing should be induced. This may be assisted by gentle but firm pressure on the lower parts of the chest. A feed should be given, with stimulant, if necessary, after the expulsive efforts. The nurse should be instructed to use soft swabs of ordinary absorbent wool on forceps for removing the expectoration which is liable to accumulate at the back of a weak patient's tongue. This must be done gently and with great care. The position of the patient in bed should be changed and he should not be allowed to assume the same position for more than four hours in succession. This is especially desirable when the patient of any age is feeble and apathetic. Frequent examination of the posterior aspect of the chest is useless and prejudicial, but the condition of the heart should be ascertained daily, in order that any signs of dilatation may be detected as early as possible.

Treatment and precautions must not be relaxed after the temperature falls to normal, and increased care is necessary if the temperature comes down without a corresponding improvement in pulse and respiration rate. It should be remembered that broncho-pneumonia is a disease in which relapses are remarkably frequent, therefore the general treatment advocated above, including diet, should only be altered gradually. Stimulants may be eliminated either by reducing the doses ordered, or by diminishing their frequency. The same principle applies to the diet. Where convalescence progresses favourably, at the end of a week or ten days, tonics, such as vinum ferri, cod-liver oil, cod-liver oil and malt, Fellow's syrup may be given in place of other medicines, and the diet gradually adjusted.

Unfortunately every case does not resolve in a satisfactory manner. It may thus be necessary to employ treatment to expand the lungs and to get rid of consolidation which does not clear up spontaneously, *i.e.*, unresolved broncho-pneumonia. If this condition persists for any length of time, as is especially liable to happen after measles or so-called influenza, bronchiectasis or fibrosis of the lungs follows. Under these circumstances every effort should be made to improve the health rapidly. Children, however small, may be placed in the open-air, under shelter. In the case of older children and adults expansion may be induced by the employment of any device which produces prolonged expiration. Among these, blowing into a bottle from which coloured fluid is raised into a glass tube is satisfactory and may be instituted as a game or competition under the supervision of the nurse. Not more than ten efforts twice a day should be allowed. In younger children this is impracticable, and the result arrived at should be produced by regular pressure exercises on the lower part of the chest to assist expiration. In adults Yeo's open perforated zinc inhaler, on the sponge of which a few drops of the following are placed, is of much advantage and should be employed twice a day for periods commencing with ten minutes and gradually working up to four hours at a sitting: Creosote, ʒiij; Carbolic Acid, ʒj; Thymol, ʒij; Sp. Chlorof., ad ℥j.

The face where the mask touches should be rubbed over with vaseline, as this liquid burns the skin when it remains in contact with it. When in spite of these means a part of the lung, usually the base, still remains solid at the end of a fortnight or three weeks after convalescence has set in, the lung should be punctured with an exploratory needle, as in exploring for empyema, and a culture tube should be inoculated with the contents expressed from the needle. From the growth thus produced a vaccine is to be made. As the organism in these cases is usually a pneumococcus, the dose recommended for children under two years of age should be small, about 5 to 10 thousand organisms. The injection should be repeated once a week, the dose being gradually increased. Sometimes the act of puncturing the lung will start resolution, and it will be unnecessary to inject the vaccine.

It should not be forgotten that adenoids and enlarged tonsils are not infrequent sequelæ of broncho-pneumonia. Prolonged anæmia should be treated by change of air, to the seaside if possible, and tonics. Patients who do not put on flesh rapidly should be treated in a similar manner. Some alarm may also be caused by the fact that a cardiac murmur may be detected. This usually disappears under general tonic treatment in the course of six or nine months. Finally, it must be remembered that latent tubercle in the lungs may become active after or during an attack of broncho-pneumonia, and though the signs and symptoms may temporarily abate there is still a danger of renewed infection.

J. C. BRISCOE.

CHRONIC INTERSTITIAL PNEUMONIA.

PROPHYLAXIS in this disease consists especially in doing everything possible to promote complete resolution in the later stages of acute inflammation of the respiratory organs.

Once the disease is established, however, climatic treatment is of considerable value. In the summer, bracing air is undoubtedly the best ; but in the spring and winter a climate should be sought which is warm and not subject to rapid changes of temperature or cold winds or much alteration in the degree of humidity, such as Egypt, Madeira, the Canary Islands, or certain parts of the Riviera: or if the patient cannot go abroad, he may be able to take advantage of the comparatively mild atmosphere of the south-west coast of England, some parts of the west coast of Scotland, or some parts of Ireland. The country is always preferable to the town, and especially so when the latter is subject to fogs. The patient should live out-of-doors as much as possible, but when the weather is damp and cold it may be wise to remain indoors; the rooms of the house, however, being thoroughly ventilated. Any occupation involving the inhalation of dust is especially harmful, while all measures for promoting and maintaining the general health and nutrition at the highest possible level should be systematically followed. The patient should take an abundant quantity of varied and nourishing food, and when the appetite is not good, mineral acids and bitters or other remedies should be prescribed. Such tonics as iron, arsenic, quinine, the hypophosphites, and cod-liver oil are generally of much service.

Within recent years injections of fibrolysin have been used, and some writers have claimed good results from them. When there is evidence of spasm of the bronchial muscle, iodide of potassium is indicated.

The main risks which the patient runs are those of bronchial catarrh and broncho-pneumonia. Therefore he should be most carefully instructed in prophylactic measures relating to those complaints. All possible causes of catarrh, such as an insufficient supply of warm clothing, cold feet, and exposure to cold or sudden variations of temperature, should be avoided. If the patient is obliged to go out in bad weather, it may be desirable for him to protect the air passages by wearing a respirator or some other covering of the nose and mouth. If bronchial catarrh, whether acute or chronic, or broncho-pneumonia occur, they should be treated as early and thoroughly as possible. In fact, the prevention and management of bronchial catarrh and broncho-pneumonia constitute by far the most important part of the treatment. It is most important to promote expectoration and to prevent decomposition of the secretion. The medical attendant should be on the lookout for indications of bronchiectasis, so that it may be treated in its earliest stages. These, as well as hæmoptysis, cardiac failure, fœtid bronchitis, and other complications, should be treated as described elsewhere.

FREDERICK W. PRICE.

CONGESTION AND ŒDEMA OF THE LUNGS.

CONGESTION and œdema of the lungs are in the majority of cases secondary to disease elsewhere, consequently in their treatment a careful search for the primary condition leading to the circulatory disturbance in the lungs is of the utmost importance. Attention must be directed especially to the heart, since failure of either ventricle or impediment to the return of blood from the lungs into the left auricle may give rise to marked stagnation in the pulmonary blood-vessels.

Although congestion and œdema are intimately associated, the clinical characters may vary in different forms, and for purposes of treatment the following clinical classification is convenient:

(1) Acute Congestion. (2) Chronic Congestion. (3) Hypostatic Congestion. (4) Œdema.

Acute Congestion of the Lungs.—This is usually an active process, being due to increased afflux of blood to the lungs through the pulmonary and bronchial arteries. It may be general, as in the forms induced by excessive or prolonged exertion, by the inhalation of hot air or irritating gases and by exposure to cold. The treatment is to secure relief to the engorged right heart by warm baths, by diaphoretic and diuretic mixtures and by purgatives. Cardiac tonics and stimulants may be given as they are required.

Acute congestion is more commonly localised and occurs to some degree at the onset of every inflammatory disease of the bronchi, lungs and pleuræ, but in such cases it demands no special treatment unless it is excessive. A primary form of acute congestion is described by French physicians under the name of *Maladie de Woillez*, but in this country these cases are regarded as instances of mild or abortive pneumonia, and are treated accordingly.

One of the most important varieties of acute congestion is the so-called collateral or fluxionary hyperæmia which occurs with rapidly developing pleural effusions, and after their too rapid evacuation, with pneumothorax and with widespread consolidation in pneumonia. These cases demand prompt treatment owing to the dangers of cardiac failure and of rapidly spreading œdema. When acute congestion occurs with large pleural effusions, more especially if signs of positive pressure co-exist, and if there are marked signs of cardiac embarrassment, paracentesis should be performed; no attempt, however, being made to withdraw all the fluid. If faintness comes on, or the patient is much distressed, ½ oz. of brandy with 10 min. of tincture of digitalis, diluted with water, may be given. In other respects the treatment is similar to that of chronic congestion. If œdema develops so rapidly in any of these conditions as to threaten suffocation the treatment described under Hyperacute Œdema should be promptly carried out. In pneumonia, fluxionary hyperæmia may be an early condition, developing before the signs of consolidation are marked. In such a case leeching or venesection may be beneficial. In the later stages of pneumonia fluxionary hyperæmia of the opposite lung or of the uninvolved parts of the affected lung may constitute a grave danger by diminishing the area available for aëration still further. In such cases oxygen inhalations and cardiac tonics are the most valuable aids, venesection being only employed if the case is of sthenic type. In giving oxygen it should be warmed and moistened with water or alcohol vapour by being allowed to bubble through a wash bottle, a mask such as that recently recommended by Dr. Leonard Hill, with side pieces of fabric, being used. The cardiac tonics which may be employed are digitalis, strophanthus, caffeine, strychnine and camphor, together with general diffusible stimulants, such as ether, ammonia and alcohol. The methods of administering these remedies are similar to those described in the next section.

Chronic Congestion, or brown induration of the lungs, is almost invariably a secondary result of cardiac enfeeblement or failure. It occurs in its most typical form in valvular disease of the left side in the stage of broken compensation. Not infrequently a marked degree of congestion occurs in mitral stenosis with some suddenness. It leads to cyanosis, dyspnœa and marked distress, and is associated with grave danger unless the right ventricle is relieved and the left ventricle restored to some degree of effective contraction.

Similar but more gradual forms of congestion develop in association with cardiac failure from any left-sided valvular lesion or from myocardial failure from any cause, also from failure or enfeeblement of the right ventricle in association with chronic bronchitis, emphysema and most chronic lung diseases. A more rare cause and one difficult to treat is that induced by pressure of an aneurysm or tumour on the pulmonary veins.

The obvious indications for treatment are: (1) To relieve the engorgement of the right ventricle; (2) to promote the contraction of both ventricles; (3) to relieve any mechanical impediments to the pulmonary circulation; (4) to promote the aëration of the blood.

Patients with marked pulmonary congestion will, as a rule, be best in bed, or, if orthopnœa is a marked symptom, they should be propped up with a bed rest and pillows or allowed to sit up in a special chair.

When there is mechanical obstruction from hydrothorax this must be relieved by paracentesis if it be of sufficient extent. If the engorgement of the right side of the heart is a marked feature, as evidenced by cyanosis, and turgidity of the cervical and other veins, prompt relief may be afforded by venesection, with the withdrawal of from 8 to 16 oz. or even 20 oz. from the bend of the elbow. If this is impracticable, it has been suggested that direct puncture of the right auricle should be performed, but this can seldom be advisable. Venesection should not be employed in cases of aortic regurgitation, and only with extreme care in very old people with emphysema and diseased arteries, because of the danger of fatal syncope. If venesection is not desirable, leeches may be applied over the liver or in the axillæ, as many as from six to nine being applied, and bleeding encouraged by fomentations after their removal. Other derivative agents may also be given, viz., purgatives, diaphoretics and diuretics. It should, however, be borne in mind that these agents are slow and indirect in their mode of action. Of the purgatives, salines such as sulphate of soda or Epsom salts, which are rapid in action and lead to watery evacuations, are most useful. Other hydragogues, like jalap, scammony and elaterin, may be employed in appropriate doses and mercurials, such as calomel or the pil. hydrargyri are preferred by some. The diuretics and diaphoretics are usually given in conjunction with the cardiac tonics; spiritus ætheris nitrosi, scoparium, acetate of ammonia and citrate of potash may thus be of some assistance. Guy's or Baillie's pill, the pill of digitalis, squill and mercury, may be given at night for this purpose.

After the relief of the right heart, the most important measures are those directed to improving the force of the ventricles. For this purpose digitalis is the most valuable agent. The tincture may be given in doses of from 10 to 15 min. every four hours in some such mixture as the following: Ammon. Carb., gr. 4; Tinct. Digitalis, ♏12; Sp. Ætheris, ♏10; Aquam, ad ℥j.

In Germany the powdered leaves in pill or the freshly prepared infusion are used in preference. In urgent cases digitalin ($\frac{1}{100}$ to $\frac{1}{50}$ gr.), or strophanthin ($\frac{1}{500}$ to $\frac{1}{200}$ gr.) may be given by the mouth, hypodermically or intravenously. It should be remembered that hypodermic injection of digitalin and strophanthin is painful.

Cloetta's preparation, Digalen, may also be given instead of digitalis. A mixture of strychnine, strophanthus and caffeine may be useful: ℞. Tinct. Strophanthi, ♏5; Caff. Cit., gr. 5; Liq. Strychninæ, ♏5; Aq. Camph., ad ℥j [U.S.P. ℞. Tinct. Strophanthi, ♏1; Caffein. Cit., gr. 5; Strychninæ Hydrochlor., gr. $\frac{1}{22}$; Aq. Camph., ʒij; Aquam, ad ℥j]; every six hours.

In cases where digitalis fails, or more rapid effects are required, hypodermic injection of strychnine may be of great value, $\frac{1}{60}$ to $\frac{1}{30}$ gr. every four or six hours. Camphor is also of value. It is given hypodermically in doses of from 10 or 15 gr., dissolved in sterilised almond oil (10 gr. to the drachm). The injection may be repeated within twelve hours if necessary. From my experience an injection of camphor is of more permanent value than an injection of ether. Nitrites may be given in cases with marked hypertension.

Energetic counter-irritation of the bases of the lungs is often valuable, especially if cough is becoming infrequent and there is increasing dyspnœa with inability to expectorate, or if there is much pain. Turpentine stupes, a mustard leaf, mustard and linseed poultices, or flying blisters, may be applied according to personal predilection or convenience. Sometimes dry cupping of the bases is more effective.

If there is grave cyanosis and dyspnœa, oxygen inhalations may be given according to the directions already mentioned in the previous section.

Alcohol may be given to these patients sparingly and as a temporary expedient, good brandy, whisky, or champagne being the best forms. It is important to secure sufficient sleep as the most valuable cardiac and general tonic, and probably chloralamide, trional or small doses of morphine are the best drugs for this purpose, the latter being only used with great care.

In regard to food, this should be chiefly liquid or soft, and should be given in small amounts at any one time so as to avoid over-distension of the stomach, which leads to further cardiac embarrassment. In cases secondary to cardiac disease, French writers insist on the importance of a *régime lactée* or rigid milk diet.

Hypostatic Congestion is a form of passive congestion occurring in the most dependent parts of the lung, due partly to enfeebled circulation and partly to the action of gravity, both factors leading to engorgement of the blood-vessels.

It is very frequently seen in the aged or enfeebled, especially when bedridden. Indeed it is one of the most frequent terminal incidents in chronic diseases of a dynamic character. The treatment is in general the same as for chronic congestion, but at the slightest indication of its onset preventive measures should be employed. The patient should shift his position frequently or be shifted from side to side. He should not be kept in a recumbent position for long periods but allowed to sit up frequently. Jürgensen recommended breathing exercises, the patient taking regular deep breaths at intervals, but this requires care lest fatigue and extra strain on the heart result. Good nourishing food should be given at frequent intervals and brandy if the pulse shows signs of failing. In other respects the rules suggested for chronic congestion should be followed.

Œdema of the Lungs.—A certain amount of exudation into the alveolar walls or alveoli is probably an invariable accompaniment of all forms of congestion. In some cases, however, the quantity of fluid may be so large as to influence markedly the symptoms and physical signs, while in others it is poured out with such rapidity as to cause imminent danger of suffocation within a few minutes of its onset. These cases are often distinguished as acute, fulminating or hyperacute œdema. The causation of œdema is in the main the same as that of chronic congestion, but in addition it occurs in association with nephritis, in certain poisonings and after epileptic fits.

In *mild cases* the treatment is practically that of the congestion to which it is due, but, in addition, expectorants may be given to promote the coughing up of the fluid.

If there is general anasarca the patient may be allowed to sit up in a chair, and his legs, on swelling up, should be tapped by means of Southey's tubes. It sometimes happens in cases with old pleural adhesions, that œdema of the lung occurs on that side, while fluid is exuded into the pleura on the other. The latter should be withdrawn if it is of sufficient quantity to cause marked embarrassment of the breathing. In cases due to renal disease, the appropriate treatment for nephritis should be adopted. In such cases a strict milk diet or even a salt-free diet is recommended by French physicians.

In the *hyperacute or fulminating forms of œdema,* to which special attention has been drawn recently by Dr. Leonard Williams, there is considerable difference of opinion as to the best methods to be adopted. The following measures have been recommended: (1) Prompt venesection, withdrawing 12 to 20 oz.; most authorities recommend this, but a few express themselves unfavourably; (2) hypodermic injection of strychnine ($\frac{1}{60}$ to $\frac{1}{30}$ gr.) every fifteen minutes until $\frac{1}{10}$ gr. has been given; (3) hypodermic injection of atropine ($\frac{1}{30}$ gr.) either alone or together with strychnine;

(4) morphine ($\frac{1}{4}$ gr.) has been recommended, but its use is condemned by many writers; (5) repeated dry cupping or the application of large sinapisms to the chest have both been highly praised by some writers on this subject; (6) the nitrites and chloroform have both been tried, but their use is condemned by many.

In all probability the most satisfactory treatment is prompt venesection followed by injections of strychnine and atropine. Later digitalis and its substitutes may be given. Oxygen inhalation may be tried, but as the patients are usually very restless and in a state of great alarm, it may be almost impossible to carry out.

R. A. YOUNG.

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EMPHYSEMA AND ITS VARIETIES.

Emphysema may be defined as a dilatation of the alveoli of the lungs with atrophy of their walls.

Certain varieties are recognised. The most common form known as *hypertrophic* or *large-lunged emphysema*, is generally associated with chronic bronchitis. *Senile atrophic* or *small-lunged emphysema* is, as the former term denotes, a condition associated with advanced age. *Compensatory emphysema* is always secondary to some other lung affection; thus, the alveoli surrounding an old tuberculous lesion are frequently found distended. By *acute vesicular emphysema* is understood a dilatation of healthy alveoli. This condition occurs in acute bronchitis and in other diseases where increased strain is thrown upon those portions of the lungs which are the least compressed during expiration. Sir J. Kingston Fowler has pointed out that as atrophy of the alveolar walls is an essential part of the morbid anatomy of emphysema, this form cannot be accepted as a true variety of the disease; nevertheless, it would be inconvenient to consider the condition under a separate heading. In *interstitial emphysema* air escapes into the connective tissue of the lungs, and since the alveoli are usually healthy, this also does not conform with the original definition. Diphtheria and whooping cough are the most usual maladies with which it is associated.

Emphysema, when once established is, owing to its nature, permanent, though much may be done to alleviate the symptoms. The treatment of the affection lies, therefore, in attempting to prevent its occurrence and to limit the increase of its extent, and in the relief of its manifestations; in other words it is preventive and palliative.

HYPERTROPHIC EMPHYSEMA.

Preventive Treatment.—An essential element in the development of emphysema is increased tension in the lungs; all factors, therefore, that may bring about over-tension must be guarded against. One of the most potent causes of increased tension is cough; in order to cause true emphysema this symptom must have existed for some time, and some deterioration of the alveolar walls must exist, and, as above mentioned, it is in connection with chronic bronchitis that emphysema is so commonly met with. The preventive treatment of emphysema is then largely the same as that for bronchitis. All causes of catarrh of the lungs must be avoided. It is obvious that the choice of a climate is all important. Change of residence is often desirable, but unhappily not always possible; although it may be an easy matter for the physician to order such a procedure, it may be almost impossible for the patient to follow that advice. For individuals so situated every care must be taken to prevent chill by means of warm clothing and avoidance of cold, damp and exposure generally. For those who are more fortunately placed certain localities offer especial advantages. The Mediterranean coast, especially Mentone, or Algiers, Egypt, Teneriffe, Madeira, the West Indies, Southern California or Florida, in America; whilst in this country, Bournemouth, Falmouth, Ventnor or Torquay, afford suitable resorts during the winter months. As a rule, there is a tendency to seek a change too late in the year and return too early. Departure should take place not later than the middle of October, and the return not before the middle of May.

Whilst discussing climate, the avoidance of asthmatic paroxysms may be mentioned. Asthma is a frequent cause of emphysema, and the more frequent the paroxysms the more is the emphysema likely to develop; such a climate must be sought in which the individual is most free from attacks. Each asthmatic is a law unto himself and no definite rules can be laid down. Algiers is usually considered to be a good climate for asthmatics, but the writer was consulted by a gentleman who had been free from asthma for ten years, when he had occasion to go to Algiers. The asthma at once returned and continued the whole week he was there, disappearing on his departure from the place.

Another factor in the development of emphysema is excessive muscular effort. Those individuals who are prone to attacks of bronchitis should choose occupations free from dust and which do not entail exertion which throws especial strain on the respiratory system; of these may be mentioned the constant playing of wind instruments, smiths, and any employment which necessitates frequent lifting of heavy weights. All these circumstances tend to increase the amount of emphysema, which develops secondarily to the bronchitis. Further, constant exposure to all forms of weather, especially during the early and later months of the year, such as occurs in cab-driving, naturally tends to the occurrence of bronchitis.

According to the definition of emphysema given at the commencement of this article, atrophy of the walls of the alveoli of the lungs forms part of the pathology of the disease. If this atrophy could be guarded against, a valuable prophylactic measure would be established. In a considerable proportion of the cases the atrophy is a natural degenerative process incidental to advancing age. Attempts have been made to lessen the tendency to degeneration by strict rules of life. Doubtless excess in diet tends to hasten the degenerative processes. Alcohol, especially, should only be taken in small quantities, and always with meals, and all sweet wines should be entirely avoided. Digestive disturbances must receive prompt attention and the bowels regulated. Carbohydrates and fats should be limited, whilst nitrogenous foods may be taken with more freedom, provided that the kidneys are sound. Patients subject to bronchial attacks frequently eat too much and become stout and plethoric, and this naturally increases their troubles. Dyspnœa is readily experienced, and the muscles of the heart may become degenerated; this leads to pulmonary congestion, requiring greater respiratory effort and thus increase of the emphysema. Smoking should be rigidly restricted, or better, altogether forbidden.

Freund was the first to suggest that some cases of emphysema originate in a specific calcification of the costal cartilages. Early calcification of the cartilages favours the formation of emphysema by decreasing the elastic recoil of the thorax and so holding the chest continuously expanded, that is to say, in the position of full inspiration. It has been suggested that by continuously exercising the chest this tendency to early calcification may be lessened, and at the same time an effort should be made to keep down the amount of lime in the blood by administration of the citrates of soda and potash. Judicious and regular breathing exercises and the use of light dumb-bells may prove beneficial, but there is often a tendency for patients to exceed their instruction in these respects, and observations should be made to assure that the exercises do not produce respiratory distress.

Palliative Treatment.—Drug treatment will first be discussed. Patients usually ask for advice not on account of the emphysema but on account of the accompanying bronchitis, or because a dilated heart is giving rise to symptoms. The treatment will then be that appropriate to those conditions.

In the intervals of the bronchitic attacks attention must be directed to the general condition of the patient, the heart and arterial system being carefully examined. An attempt must be made to keep the arterial tension within normal limits. General tonics may be given, such as nux vomica or strychnia, iron or arsenic, or if the action of the heart is not satisfactory, digitalis or strophanthus may be ordered. Arseniate of iron (gr. $\frac{1}{12}$) with extract of nux vomica (gr. $\frac{1}{4}$) may be given in the form of a pill three times a day after food. Out-patient experience proves that cod-liver oil has a soothing effect; emphysematous patients who have previously taken it will anxiously inquire if they may continue with it.

After an attack of bronchitis or asthma, iron and strychnine will be found useful. The following is a good formula: Ferri Sulphatis, gr. 2; Liquoris Strychninæ, ♏4; Magnesii Sulphatis, gr. 15; Spiritus Chloroformi, ♏10; Aquam, ad ℥j. [U.S.P. ℞. Ferri Sulphatis, gr. 2; Strychninæ Hydrochlor., gr. $\frac{1}{28}$; Magnesii Sulphatis, gr. 15; Spiritus Chloroformi, ♏8; Aquam, ad ℥j.] Three times a day after food.

If the pulse is weak digitalis or strophanthus will be required; which of the two is employed will largely depend on the age and general condition of the patient. In subjects where there is marked degeneration of the arteries, the writer prefers strophanthus, as this drug raises the tension less than digitalis.

As already mentioned, arterial tension must be carefully regulated. Many patients will be found to have a high tension; in such cases a useful combination may be made of cardiac tonics and vaso-dilators. Iodide of potassium is a most useful remedy in bronchial affections, but owing to its depressing effect on the heart it must be combined with stimulant preparations, aromatic spirit of ammonia being the most convenient. If the heart has become dilated owing to the embarrassment of the pulmonary circulation, tincture of digitalis (♏5 to ♏10), combined with nitrite of sodium (gr. $\frac{1}{2}$ to gr. 1), may be used in elderly patients.

The possible existence of the gouty diathesis must not be overlooked. A course of treatment at a suitable spa may then be recommended with advantage. At some of these special facilities exist for the treatment of pulmonary affections, notably emphysema and asthma; further reference will be presently made to this part of the subject.

Attention has already been drawn to the importance of regulating the diet in emphysematous subjects. Attacks of indigestion are common; flatulent distension of the stomach and bowels considerably adds to the patient's discomfort and dyspnœa is easily aggravated. In addition to directing the diet on the lines already indicated, an alkaline bitter medicine containing 5 min. [U.S.P. 12 min.] of tincture of nux vomica may be given before, and 1 min. of creosote in capsule directly after food.

The mechanical methods for the relief of emphysema have received more attention in other countries than in England. After extended experience, the writer can speak in favourable terms of the effect of the compressed air bath. As constructed at the Brompton Hospital, it consists of a large metal chamber, capable of comfortably seating four patients. Air is forced in by means of an engine, first passing through a receiver containing layers of cotton-wool for purposes of filtration. A "bath" occupies two hours. Half an hour is required to raise the pressure slowly to the full height required; this is maintained for one hour, and during the remaining half hour the pressure is reduced to the normal. For emphysema and asthma the added pressure is equal to 9 lb. above the mean atmospheric pressure. In the majority of cases the patients state that the breathing is much easier whilst they are in the bath, and after a few baths the effect is more lasting, so that after about twelve baths have been taken considerable improvement is experienced. The baths are best given at first twice a week, until four have been taken, then three times a week, until ten have been taken, and they may then be administered every other day. Twelve may be regarded as the minimum number required to produce a definite effect, whilst it is desirable to give twenty, or even more. In many instances the beneficial results have apparently been permanent, at any rate, the paroxysms of dyspnœa have not returned. In others, the relief experienced was so great that a second or third course was eagerly asked for at considerable intervals of time. The best results were obtained in cases of asthma complicated with emphysema, but such instances would more suitably be considered under the heading of "asthma."

At some of the continental resorts the compressed air baths are much larger. At Dr. Dietz's establishment at Kissingen one of the baths holds twenty patients, and is suitably fitted up as a sitting-room. Certain observers have pointed out that expiration into rarified air should give relief, and various forms of apparatus have been constructed with this object. A "pneumatic cabinet" was tried at the Brompton Hospital, but without definite effects. Dr. Dietz has had constructed in connection with one of his compressed air baths, an arrangement of tubes by which a patient surrounded by air at an increased pressure can expire into the atmosphere surrounding the bath, and claims considerable success by this method.

The exact explanation of the beneficial results of compressed air is difficult to formulate. Sir J. Kingston Fowler ("Diseases of the Lungs," p. 178) suggests that the condensed air penetrates parts of the lungs which have been long unused in respiration and in which air has been, so to speak, imprisoned at a high tension; the escape of this air is facilitated and contraction of the lung follows.

Various inhalations have been recommended for the relief of the "wheezing" of which emphysematous patients so frequently complain. Tincture of benzoin, oleum pini sylvestris, menthol and other substances may be used in the form of sprays, but the effect is only temporary. A useful formula is: Menthol, ʒij; Creosoti, ʒij; Spiritus Camphoræ, ʒij; Spiritus Rectificatum, ad ℥j. [U.S.P. ℞. Menthol., ʒij; Creosoti, ʒij; Spiritus Camphoræ, ʒij; Alcohol ad ℥j.] This may be used in a respirator, or when the attacks are not severe, it is a convenient plan to place a few layers of lint at the bottom of a small tin box, and to keep the lint moist with a few drops of the solution. The box can be kept at hand, and when required it is only necessary for the patient to lift the lid of the box and inhale the fumes.

Spray chambers have also been adopted. At the establishment at Kissingen, referred to above, large rooms are set apart in which an elaborate apparatus is provided by means of which the natural Soole water of Kissingen is thrown into a very fine spray, so that the atmosphere of the whole room is impregnated with it. The main constituent of the water is common salt, and to it is sometimes added other volatile medicaments. Patients remain in this atmosphere for two hours, so that there is every chance for the vapour to penetrate the lungs.

Freund suggested resection of the first costal cartilage or of the first three ribs on either side; some cases have been relieved by this means, but the operation is attended with some risk, and it is doubtful whether it will be much adopted.

Dyspnœa, more or less severe, is frequently experienced by patients suffering from emphysema. A certain amount of exercise may be encouraged. This may take the form of walking, first on the level and then up sloping ground of gradually increasing gradient, or of various exercises calculated to increase the power of the heart. For the more severe attacks of dyspnœa, a mixture containing 30 min. each of spiritus ammoniæ aromatici and spiritus ætheris, slowly sipped, will often give relief.

Paroxysms of coughing are frequently complained of, especially on first rising in the morning, and various drugs have been tried to relieve this symptom. A mixture that is frequently successful is: Sodii Bicarbonatis, gr. 10; Sodii Chloridi, gr. 3; Ætheris Chlorici, ♏5; Aquam Anisi, ad ℥j. [U.S.P. ℞. Sodii Bicarbonatis, gr. 10; Sodii Chlor., gr. 3; Spiritus Chloroformi, ♏4; Aquam Anisi, ad ℥j.]

This may be taken just before rising, either alone or mixed with warm water.

Another mixture which may be tried is: Sodii Bicarbonatis, gr. 10; Tincturæ Camphoræ Compositæ, ♏20; Vini Ipecacuanhæ, ♏10; Spiritus Chloroformi, ♏15; Aquam, ad ℥j [U.S.P. Sodii Bicarbonatis, gr. 10; Tincturæ Opii Camphoratæ, ♏20; Vini Ipecacuanhæ, ♏6; Spiritus Chloroformi, ♏12; Aquam, ad ℥j]: to be taken before rising in the morning. The cough is often very persistent, and if remedies similar to the above fail to give relief, chloride of ammonium (gr. 10 to 15) is sometimes successful, the taste being disguised with the liquid extract of liquorice. The vapour of ammonium chloride is also useful, and various forms of apparatus are sold for the purpose of producing the vapour by drawing air through hydrochloric acid and ammonia, and purifying by passing through water or a moist sponge.

Stimulating liniments, such as the compound turpentine preparation, are also employed with success.

ATROPHIC EMPHYSEMA.

The treatment of this form of emphysema is mainly palliative, and the same therapeutic lines are to be followed as laid down above. The alkalies and iodide of potassium may be given and an emulsion of cod-liver oil may yield relief.

Attacks of bronchitis may induce serious symptoms, and dyspnœa may become alarming. The administration of oxygen often affords relief, and alcoholic stimulants in the shape of brandy or champagne may be called for. Physical or mechanical methods of treatment are, as a rule, of little avail, although the writer had one case of a man aged 72, in which the compressed air bath yielded considerable benefit.

COMPENSATORY EMPHYSEMA.

This condition always occurs in connection with some other pulmonary lesion. No treatment can be directed to the emphysema itself, and attention must be entirely directed to the primary disease.

ACUTE VESICULAR EMPHYSEMA.

For the emphysema itself no therapeutic measures are of any avail. Efforts must be made to prevent its increase in extent by remedies directed to the bronchitis or other disease which is causing the condition.

INTERSTITIAL EMPHYSEMA.

Interstitial emphysema is rarely diagnosed during life. Air having entered the connective tissue of the lung, no artificial means can be adopted of remedying the condition, and therefore there cannot be said to be any form of treatment for this affection. As in acute vesicular emphysema, measures must be employed which are suitable for the primary affection.

FRANK J. WETHERED.

GANGRENE OF THE LUNG.

Spontaneous Evacuation may lead to cure, but only in the case of a small focus. Expectant treatment may therefore be followed, but for a short period only; with no improvement, the urgency of the condition itself and the possibility of grave complications, such as severe hæmorrhage, should lead to active surgical measures.

Treatment by vaccines may be employed, but in the writer's opinion cannot take the place of operation and drainage, though it may wisely be employed as an auxiliary to surgical measures.

J. J. PERKINS.

HÆMOTHORAX.

It is usual not to include under the term hæmothorax the hæmorrhagic effusions met with in the pleurisy of Bright's disease or cirrhosis of liver, in tuberculosis or in cancer, but to restrict its use to the true hæmorrhage produced by trauma or the rupture of an aneurysm or arising in connection with altered conditions of the blood, such as scurvy or purpura.

In the traumatic cases profuse bleeding, *e.g.*, from a wounded intercostal artery—to be known by the rapidity of the effusion into the pleura—will necessitate a search for the vessel and its ligature; in the slighter cases active intervention is unnecessary, the effused blood being ultimately absorbed.

In cases other than these the removal of the blood as dyspnœa necessitates should be considered sufficient, the uncertainty as to its origin demanding caution in proceeding to active surgical measures.

In hæmothorax associated with purpura and allied conditions general treatment in addition to aspiration must be employed, such as the administration of the calcium salts (calcii chlorid., gr. 20, quartis horis), or the intravenous injection of 20 cubic centimètres of fresh horse serum, repeated daily or every other day, as necessary.

J. J. PERKINS.

HYDROTHORAX.

Hydrothorax, or the passive transudation of non-inflammatory fluid into the pleura, is chiefly met with in conditions of cardiac failure or renal disease; though often only a part of a general dropsy, yet the pleura alone may be involved. Pressure on the azygos veins, as by an intra-thoracic tumour, may likewise occasion a hydrothorax. The fluid is clear and straw-coloured and poor in fibrin, the percentage of albumin varying from 18 to 42 per cent. *Cyto-diagnosis.*—Endothelial cells aggregated in plaques, the lining of the serous membrane washed off. by the transudation, are predominant and are characteristic of a passive effusion, in contradistinction to the lymphocytes or polymorpho-nuclear cells of the fluid of an inflammatory pleurisy.

Cardiac stimulants should be given with diuretics, *e.g.*, pil. digitalis co., and saline purgatives or elaterium (pulv. elaterini co., gr. 2) [U.S.P. trituratio elaterini, gr. ½], and a salt-free diet instituted. Apocynum tincture (♏5 to 10) has a considerable reputation for its diuretic powers under these conditions.

If cardiac or respiratory distress is marked or the effusion, even though moderate in amount, shows no signs of absorption, recourse must be had to *paracentesis.* The indications for this measure are the following: Dyspnœa; cardiac embarrassment; commencing engorgement of the sound lung; positive intra-thoracic pressure on the affected side, as a sign of which is to be taken extension of the dulness above the third costal cartilage with downward displacement of the diaphragm, evidenced by depression of the liver or the absence of the stomach note over the sixth rib in the left nipple line.

Method of Paracentesis.—The patient should lie either flat or slightly on the sound side, the arm drawn across and the hand placed on the opposite shoulder. The instruments and the skin over the site of puncture, the best point for which is the sixth or seventh intercostal space in the mid-axilla or the eighth space below the angle of the scapula, are to be as thoroughly sterilised as for any major operation. Incision of the skin, which may be anæsthetised by freezing, with the point of a scalpel, facilitates the entrance of the needle, which should be kept close to the upper margin of the rib to avoid the intercostal artery.

Only a moderate vacuum, just enough to produce a negative pressure, should be established, and no effort made to hasten the withdrawal of the fluid. Cough, pain or the appearance of blood-stained fluid call for immediate cessation, and in the case of a large effusion only a portion, not more than 1½ litre, should be withdrawn.

The object of these precautions is to prevent the onset of the condition known as *serous or albuminous expectoration*, which has mostly followed the rapid removal of large quantities of fluid and has often proved fatal. It may occur during the operation or after an interval of an hour or two, and is characterised by the almost incessant expectoration of large quantities of frothy fluid, so rich in albumin as to turn almost solid on boiling. Intense dyspnœa with extreme tachycardia are the general symptoms, while innumerable small *râles* can be heard over the affected lung. Extreme œdema of the lung has been found post-mortem, the result, it is believed, of the forcible withdrawal of fluid from the pulmonary vessels following the use of excessive negative pressure.

Urgent treatment for this complication is necessary, and relief can only be given by free stimulation, and especially by wet cupping over the affected side.

To prevent the recurrence of effusion recourse has been had to the introduction into the pleura of sterilised air or nitrogen, and this has been attended with great success, the action of the gas being purely mechanical. The method has the further advantage that by its aid large effusions can be completely evacuated without any of the dangers just described. A special form of aspirator is used, and after withdrawing a certain amount of fluid, before any great negative pressure is established, a quantity of air sterilised by passage through cotton-wool is introduced about equal in amount to the fluid removed. The withdrawal of the fluid is then completed and more sterile air is introduced, making the total amount equal to half or three-quarters of the fluid removed. Sir James Barr completes the operation by injecting 4 cubic centimètres of adrenalin solution (1 in 1,000) to constrict the vessels.

J. J. PERKINS.

PLEURISY AND PLEURAL EFFUSION (SERO-FIBRINOUS).

In the past, patients affected with pleurisy have perhaps suffered as much from the treatment as from the disease itself. Treatment, founded on false conceptions as to the pathology of the disease, was not merely injudicious and in excess, it was positively harmful.

There still linger in some of the text-books in common use survivals of the old notions as to the treatment of pleurisy. Thus sometimes even now it is recommended that the patient should be kept on a low diet in a warm room, and that he should be dosed with diaphoretics and diuretics and purgatives in order to reduce the fever and to help to get rid of the effusion. It may be said, however, that, with a better understanding of the pathology of pleurisy, more rational methods of treatment have been generally adopted. This has been brought about to some extent by the investigations which have proved that tubercle is the most frequent cause of idiopathic pleurisy. All lowering treatment such as was recommended for pleurisy is bad for the tuberculous subject, while fresh air and proper nourishment promote his recovery. Treatment which does good in one form of pleurisy has been found to be equally beneficial in others.

Rest.—As soon as it is recognised that a patient is suffering from pleurisy he should be ordered to keep his bed. Rest in bed is the best means, not only of giving rest to the affected part, of helping to subdue the inflammation and of relieving the pain, but also of reducing fever should this, as is usually the case, be present. Rest in bed should be insisted on while pain remains and the temperature is raised, and in cases with effusion until the fluid has practically disappeared.

Fresh Air.—While the patient is being kept in bed he should not be deprived of fresh air, and the windows of the sick-room should be kept open night and day. An abundant supply of fresh air helps to counteract the debilitating effects of the illness and to lower the temperature. In former days when pleurisy was generally attributed to cold, and physicians spoke of it as pleurisy *a frigore*, it was thought dangerous to open a window, and the patients were unwisely coddled and cossetted in a warm room and carefully shielded from every breath of air. The effect of this was far from beneficial. It is needless to say that there is no difficulty in keeping the patient warm while the air of the room is fresh and cool. The open-air treatment which is beneficial in pulmonary tuberculosis is no less so in pleurisy whether it be tuberculous or not.

Diet.—The diet should be light but ample. The menu may be selected from the following: Beef tea, chicken broth, bread, rusks, biscuits, butter, milk, eggs, milk puddings, sole, whiting, oysters, chicken, potatoes, or other light vegetable, and occasionally a little fruit, such as grapes or oranges. Tea, coffee, cocoa, home-made lemonade or orangeade are allowable as beverages, but stimulants are not usually necessary or desirable.

The mouth, tongue and teeth should be kept as clean as possible and a regular action of the bowels should be secured.

Relief of Pain.—Pain in the side may be best relieved by local applications. To this end warmth may be applied by means of hot-water bottles, hot fomentations, or linseed meal poultices, or cold by means of ice-bags or cold compresses. Warmth, however, is usually more comforting than cold. The application of flying blisters, a few leeches or mustard leaves will sometimes give speedy relief. Another means of relieving pain is to strap the side with ordinary strapping, which should be applied as for fractured ribs. The only disadvantage of the strapping is that it interferes with the physical examination of the chest. Other applications for relieving pain are various anodyne liniments, ointments and plasters. The well-known A.B.C. liniment (equal parts of aconite, belladonna and chloroform liniments) is excellent. It should be sprinkled on flannel or spongio-piline, wrung out of hot water, which is then applied to the seat of pain. Linimentum opii or linimentum menthol may be applied in the same way. An analgesic balsam composed of menthol (1), oil of winter green (2), and lanoline (8) is a useful local anodyne. A belladonna plaster over the seat of pain will often afford relief.

When pain is very severe, preventing sleep, the most certain means of relieving it is the administration of a hypodermic injection of morphine, but if for any reason morphine be contra-indicated, 10 to 15 gr. of acetyl-salicylic acid (aspirin) may be given by the mouth.

Relief of Cough.—The cough of pleurisy is usually dry and hacking, and, if pain be present, only serves to increase it and to add to the discomfort of the patient. The cough, therefore, should be checked, but the simpler the means used to check it the better. Various simple remedies may be tried for this purpose such as barley water, linseed tea, or solution of bicarbonate of soda

(10 gr. to the ounce) to sip, liquorice lozenges to suck, a simple linctus (such as equal parts of syrup of tolu, paregoric, and oxymel of squills), or menthol inhalation (20 drops of a 20 per cent. alcohol solution of menthol sprinkled on lint or on the sponge of an oro-nasal inhaler).

THE TREATMENT OF THE EFFUSION BY TAPPING OR ASPIRATION.

In all cases where the effusion is a large one, some of the fluid should be removed without delay. The amount of the fluid may be judged by the extent of the dulness and the displacement of the organs and the embarrassment to the breathing. When the amount of the fluid is moderate, the dulness not extending more than half-way up the back, it is advisable to watch the case for a little before deciding on tapping, so as to see whether the effusion is increasing, stationary or diminishing. During this period the side may be painted with tincture of iodine, which may be fortified if desired by the addition of strong solution of iodine. If the effusion remains stationary or increases during the few days of observation, then the side should be tapped without further delay. Other indications for tapping are the presence of dyspnœa or orthopnœa, and any such signs of weakness or embarrassment of the heart's action.

The Apparatus.—Potain's bottle aspirator apparatus is that which is most generally used. This consists of a set of trocars and cannulas with indiarubber tubes to connect with a bottle aspirator with double-way cock. Each trocar and cannula is so arranged that when the trocar is removed it may be replaced by a blunt-ended probe or pilot should the cannula become blocked by fibrinous plugs. It is well to have a lateral opening on the cannula near its free end to lessen the chance of the channel getting plugged. A very fine cannula should not be used, but the lumen of its tube should have a diameter of at least one-tenth of an inch.

A syphon apparatus is used by some. This has the advantage of simplicity, as it dispenses with the somewhat cumbrous bottle and exhausting piston, but it is safer to use the aspirator in all cases in which there is any doubt as to the presence of fluid.

The Preparation of the Patient.—The skin in the neighbourhood of the spot selected for tapping should be sterilised. This may be done by washing with ether soap and rubbing with carbolic or perchloride of mercury lotion, or by painting with chloroform iodi (15 gr. of iodine to the ounce of chloroform), the latter preferably about two hours before the tapping is to be done, Brandy and a hypodermic injection of strychnine should be ready for use in case of faintness during the operation. Small pads of gauze and some collodion should be at hand to apply to the seat of the puncture when the cannula is withdrawn.

The Selection of the Spot for Tapping.—When the amount of fluid is considerable the spot usually selected for tapping is in the axillary region in the nipple level and in the mid-axillary line, that is, in the sixth or seventh interspace. On the right side the sixth interspace should be chosen, or in the case of children the fifth, in order to avoid the liver. Another situation favoured is just external to and just below the angle of the scapula posteriorly in the ninth interspace. Where the amount of fluid is small or its situation is unusual the spot selected for tapping by the physician has to be decided by the position of the fluid.

The Position of the Patient.—According to the spot selected the patient should be recumbent or semi-recumbent, resting on the back or non-affected side, and the arm of the affected side should be drawn forward.

The Puncture.—As a rule the puncture does not give rise to any great amount of pain, and ordinarily it is unnecessary to employ any artificial means for deadening the skin. In the case of sensitive patients, however, it may be advisable to do so, and the pain of the puncture may be lessened by spraying the skin round the selected spot with ethyl-chloride or by applying a freezing mixture of ice and salt. A small skin incision made with a sharp scalpel facilitates the penetration of the trocar and cannula. The trocar should be thrust in boldly close to the upper border of the rib so as to avoid injury to the intercostal artery lying along the lower border of the rib next above.

The Withdrawal of the Fluid.—The fluid should be slowly withdrawn and to this end the air in the bottle should be only partially exhausted and the stopcock should be turned gradually and cautiously so as to control the flow of the fluid. It should be allowed to run as long as it does so freely, but no attempt need be made to withdraw the whole amount. In different cases the amount which comes away varies from a few ounces to several pints. If the fluid becomes blood stained after being clear, the cannula should be removed. Sometimes as the fluid is being withdrawn a fit of coughing comes on, which can only be stopped by withdrawing the cannula. Sometimes the cannula gets blocked and the fluid prematurely ceases to run. When such a block is suspected a blunt-ended probe or pilot should be cautiously passed down the cannula and on removal of a plug in this way the fluid may again run freely. The flow of the fluid may sometimes be re-established by manipulating the cannula so as to reach the altered level of the effusion.

When the cannula is withdrawn a small pad of gauze steeped in collodion should be applied to the place of puncture for the purpose of sealing it.

Repetition of Tapping.—It is seldom that tapping has to be repeated. The fluid left behind usually gets slowly absorbed, but in some cases it re-accumulates and tapping has to be done again and again. The indication for further tapping is the re-accumulation of the fluid to its previous proportions.

Injections into the Pleural Cavity.—One may merely mention that the suggestion has been made and carried out to inject sterilised air into the pleural cavity to replace the fluid withdrawn. This method has not received much acceptance and is very doubtfully beneficial. Injections into the pleura of suprarenal extract, normal saline, formalin (2 per cent. solution in glycerine) and liquid paraffin have also been suggested.

The Risks of Tapping.—Tapping the chest even for purposes of exploration should never be performed in the doctor's consulting room, for although as a rule the operation is free from danger, in exceptional cases serious, even fatal, results have been observed. These untoward accidents, although fortunately rare, can neither be foreseen nor prevented. One of these risks is syncope, which may occur and prove fatal at the time of the operation or within a day or two. Its cause is not well understood, but it is probably of reflex origin through the vagus. Another danger, fortunately also rare, is the supervention, after or even during tapping, of acute œdema of the lung. Such a complication is always formidable and usually terminates fatally. Strychnine and caffein hypodermic injections should be promptly administered and venesection may be performed. Hæmorrhage into the pleural cavity and pneumothorax are other accidents which have occasionally occurred.

THE AFTER-TREATMENT OF PLEURISY.

As already mentioned, acute pleurisy is in a large proportion of cases a tuberculous affection, and it is found that in many instances pleurisy is followed sooner or later by pulmonary tuberculosis. If there is any sputum it should always be examined for tubercle bacilli, and if they are present the treatment for pulmonary tuberculosis should be promptly adopted. But even when no tubercle bacilli are found the patient who is convalescent from pleurisy should be treated as though predisposed to pulmonary tuberculosis. Three to six months' holiday is not too short, and should be spent under the best hygienic conditions, the patient leading an open-air life. At the end of this time the patient should only be allowed to resume his ordinary mode of life if his health appears to be thoroughly re-established. A winter spent under proper medical supervision at a health-resort in the high altitudes in Switzerland would be usually most beneficial.

In cases in which there is **delayed re-expansion** of the collapsed lung what has been termed pulmonary gymnastics may sometimes be practised with advantage. The patient should be taught to fill the lungs slowly and thoroughly, and as slowly and thoroughly empty them, special attention being directed to the movements of the diaphragm so that it is properly brought into action. The movements of the thorax may be combined with movements of the arms and head, the principle being that those movements which help to expand the chest should accompany inspiration, those which serve to contract it accompanying expiration. Forced expirations may also be practised by blowing so as to force water from one Wolff's bottle into another. Wolff's bottles may be obtained from any instrument maker, and for this purpose their capacity should be at least a gallon. Mention may be made of Ketchum's Pneumatic Cabinet and of Compressed Air Baths. There is a good installation of the latter at the Brompton Hospital which can be used by private patients. These aids to re-expansion of the lungs are not, however, within reach of many ordinary patients, and fortunately they are not indispensable for recovery.

HECTOR MACKENZIE.

PLEURAL EFFUSION (PURULENT).

The treatment of empyemata is chiefly surgical, for as soon as it is known that a patient has pus in his chest it should be let out; but from time to time we meet with patients in whom an empyema has burst into the lung and pus is being coughed up occasionally. Such cases often do so well that it is unnecessary to open the chest to drain the empyema; sometimes we cannot by the most careful physical examination and needling of the chest find the empyema from which the pus is being coughed up, nor is this surprising, for the abscess cavity is constantly being almost emptied by coughing; lastly, we often come across patients whose empyema is very slow to heal, even when it has been opened by the surgeon. Frequently much good can be done under any of these circumstances by cultivating the principal organism or organisms in the discharge and vaccinating the patient with them. Thus, an old man in an asylum had for a long while been coughing up pus from a small empyema at the base of the right lung. He had a slightly hectic temperature. Streptococcus lanceolatus was cultivated from the expectoration. A vaccine prepared from it was given subcutaneously to the man, who had three injections in six weeks. He at once began to improve; the temperature, which had been raised for months, fell; the expectoration ceased a month after treatment was begun, and when heard of a year after the patient remained quite well. Another case was that of a woman who for many months had been coughing up pus; examination by the X-rays showed an empyema in the upper part of the right chest. Bacillus coli, a streptococcus and a pneumococcus were cultivated from the pus. Examination of the opsonic indices suggested that the most harmful of these was the bacillus coli. An autogenous vaccine of it was prepared. She had four doses of this. The expectoration quickly ceased; she gained 2 stone in weight, and improved in every way. A second X-ray examination showed great shrinkage of the empyema. A man coughed up a hepatic abscess through his lung; he was sent to lie in the open air by the sea and greatly improved in all respects, but the expectoration of pus did not quite cease. Several micro-organisms were found in the expectoration, but the most important appeared to be Streptococcus pyogenes longus. An autogenous vaccine was prepared and given, with the result that the expectoration soon ceased. Unfortunately this treatment sometimes fails. If it is desired to try by needling to find an empyema from which pus is being coughed up, it is well to give the patient a good dose of morphia at night so as to prevent coughing. The pus then collects in the empyema, and when the patient wakes may be found with a needle.

Abundant fresh air, indeed living out of doors day and night, is often very helpful to the healing of empyemata, and in order to aid the expansion of the lung it is well to make the patient take several deep breaths many times a day, or he may blow water from one Wolff's bottle to another. The force necessary to do this can be graduated by varying the depth of the water in the bottles.

W. HALE WHITE.

THE SURGICAL TREATMENT OF EMPYEMA.

More than one-third of the cases of this affection occur in children under five years of age.

The various organisms found include the pneumococcus, which is the most common in children and adults, but in the latter the streptococcus may be mixed with it or it may be present in pure culture. Staphylococcus and bacillus coli, and the tubercle bacillus, are found in many cases; the first may be associated with septic wounds of the chest or other parts, the second occurs in empyemata complicating appendicitis, and the last in those more chronic cases which differ clinically from the others and should be considered apart from them. The symptoms and diagnosis of these effusions are in the hands of the physician. Absorption of acute purulent effusions without surgical interference is extremely rare, although cases have been reported in which those due to the pneumococcus are said to have absorbed spontaneously. These effusions may be *generalised* in the lower part of the pleural cavity or *localised* (1) between the outer surface of the lung and the costal pleura; (2) between the diaphragm and the base of the lung; (3) in a fissure between two lobes or between the lung and mediastinum.

Certain aphorisms are worthy of remembrance as a prologue to the treatment of empyema.

Never proceed to incise the chest or to resect a portion of a rib without previously exploring the chest with an aspirating syringe or aspirator. Aspiration should only be performed as a *preliminary* to operation or as a temporary measure. And finally, to quote from Sir William Osler, "It is sad to think of the number of lives which are sacrificed annually by the failure to recognise that empyema should be treated as an ordinary abscess—by free incision. Even in the most desperate cases the surgeon should never hesitate to make a free incision."

(1) Empyema Generalised in the Lower Part of the Thorax.—*Choice of Anæsthetic.*—When the patient's condition is such as to render a general anæsthetic dangerous, withdraw sufficient fluid to relieve the respiratory embarrassment by paracentesis through a large sized cannula. Wait a day or two and then incise and drain in the ordinary way.

Preparation of the Patient.—The skin over the affected side should be rendered aseptic, for although micro-organisms are present in the chest, it is important not to introduce any fresh ones.

Position of the Patient.—The patient should lie horizontally on the table with the affected side projecting over the edge. If the respiratory embarrassment is not serious the patient may be allowed to lean a little towards the sound side.

The surgeon will operate sitting and rather from below the patient's chest. An alternative position is to turn the patient entirely on to the affected side, and for the surgeon to stand on the opposite side and operate from behind.

Choice of Rib and Site of the Part to be Resected.—From the writer's experience the eighth rib just in front of the line of the angle of the scapula is a good position to choose. Most surgeons will agree that a portion of a rib should be resected, for this proceeding enables the surgeon (1) to explore the pleural cavity thoroughly with the finger; (2) to estimate the amount of collapse of the lung and the extent of the abscess cavity; (3) to withdraw any large fibrinous masses which would otherwise block the tube and retard proper drainage; (4) to prevent nipping of the tube between the ribs and the imperfect drainage which results therefrom.

It is best to consider incision between the ribs as a temporary measure which can be performed more rapidly in the more desperate cases, for it is impossible adequately to explore the pleural cavity with the fingers through an intercostal incision. The preservation of the periosteum of the rib is a fetish which should be got rid of; the writer has found that better drainage is obtained by removal of 1 inch to 1½ inches of rib with its periosteum, especially in children. It is argued that in pneumococcal cases the period required for drainage is so short that the question of regeneration is not important. In the majority of cases this period is short, but in others it is more prolonged, and it is not possible to foretell with any accuracy which cases are likely to heal rapidly and which will require more prolonged drainage.

Removal of the rib and periosteum takes no longer time and does not produce any weakness of the chest wall afterwards, but it produces good drainage and obviates the necessity for a further operation.

The routine method of removal of 1 inch to 1½ inches of the rib with its periosteum will be found a most satisfactory one in practice.

The line of the angle of the scapula is the best site from which to remove the piece of rib.

The fact that the ribs are here overlapped by the latissimus dorsi muscle makes no difference when it is seen by a glance at the anatomy of the thorax, especially in transverse section, that drainage at this site on a level of the eighth or ninth rib must be good whether the patient be sitting up or lying down. Further it is not uncommon for a counter-opening to be necessary if drainage is attempted in the mid-axillary line.

Although in adults the ninth rib in the scapular line may be chosen, it is better to choose the eighth or even the seventh in children, for often the parietal pleura covering the ribs becomes adherent to the parietal pleura covering the diaphragm, thus obliterating the "diaphragmato-costal sinus," making the two layers one and occasionally causing the operator to open the abdominal cavity.

Operation.—So soon as the exact portion of rib to be excised has been decided upon steady the skin over the rib by placing the thumb and forefinger above and below the portion of rib. Cut firmly on to the bone and prolong the incision along the bone for 2 to 3 inches. Incise the periosteum vertically in two places at a distance of 1 to 1½ inches from each other. Separate the muscles from the upper and lower border of the rib by a rugine and introduce the rugine from above between the rib and pleura and push it along to one end of the incision beneath the vertical incision through the periosteum. Divide the rib by cutting forceps in this situation, then move the rugine to the other end and divide the rib again and remove the piece with sequestrum forceps. Do not trouble about any bleeding there may be unless you see the actual vessel spouting. The bleeding, if any, stops in practically every case as soon as the pleura is opened.

Introduce a pair of sinus forceps into the centre of the space left after removal of the rib and push it gently inwards until the pus is reached. Where the pleura is thick it may be incised carefully with a knife in a line parallel to the ribs for almost the whole of its thickness and the sinus forceps subsequently pushed in. Separate the blade of the forceps and allow the pus to flow out slowly. Do not make the opening too large in the first place or there may be a sudden gush of pus causing syncope from a too rapid relief of intrathoracic pressure. When this pressure has been slowly relieved by the evacuation of some of the pus which will now only flow out a little during inspiration, introduce the finger and estimate the amount of collapse of the lung and remove any fibrinous masses which may be felt. These may be brought near to the opening by the finger and pulled out with forceps. It is not advisable to wash out the pleural cavity.

Expansion of the Lung.—When the finger has removed the fibrinous masses and estimated the condition of the lung it is possible to ensure a certain amount of expansion, especially in children, by plugging the wound of the pleura with the finger and allowing the patient to come round a little from the anæsthetic, and when he coughs withdrawing the finger. A little pus will escape and the finger again plugs the wound as the inspiratory effort is made. If the operation has been undertaken before the lung has become very collapsed or adherent, the lung can be made to expand a great deal by this method and sometimes in early pneumococcal cases almost completely; in such cases it may not be necessary to drain. A little protective may be placed over the wound to act like a valve and to allow the pus to escape during coughing, but to close the opening during inspiration. A large antiseptic dressing is placed over the protective.

Drainage.—In all streptococcal cases and in all cases where the lung does not expand drainage is necessary. In *pneumococcal cases* a tube 2¼ inches long is sufficient; let it be without lateral holes but with a semicircular piece cut out of the end of it so that the lung when it expands will not block it. Use a tube almost as thick as the space between the ribs will allow. In *streptococcal* cases where the lung is collapsed introduce a director into the wound until it touches the lung, measure off the length and cut the tube as above about an inch shorter than the distance from the wound to the lung.

Numerous varieties of tube for empyema have been advocated. In the first instance it is best to use a simple straight tube and stitch it to the skin or a tube with a flange may be used from the first. The important point is to use a kind of tube whose habits are familiar and to see that one individual dresses the case throughout, so that there may be no mistake as to whether the tube has been removed or not. By these means there will be no chance of the tube slipping unknown and unchronicled into the pleural cavity.

Use the protective dressing for the first two days and throughout the whole course of treatment preserve the strictest aseptic precautions.

After-treatment.—The patient may be very collapsed after the operation and embarrassed by the change in his respiratory conditions. Treat the collapse on the usual lines and let the patient lie on his affected side and a little raised up for the first day or so. It may be necessary to change the dressings two or three hours after the operation and it must be remembered that nothing makes a patient more uncomfortable than dressings soaked with pus. Use sterile gauze, wrung out in a little weak sanitas solution if the pus be foul smelling, and plenty of absorbent wool.

The drainage tube may be changed after the stitch has been taken out about the fourth or fifth day. As to when the tube should be removed depends a great deal on the results of bacteriological examination of the pus removed. In pneumococcal cases in children keep it in so long as pus is coughed out on to the dressings; a few cases of this kind may need no drainage, but in the large majority the tube will remain in from three days to three weeks.

As a rule, it will be about a week before the tube is taken out, and it is almost better in this type of case to take the tube out a little too soon.

If there is any tendency to reaccumulation of fluid, notice whether it is pus or serum; if the former reintroduce the tube for a few days, if the latter introduce a railway catheter once or twice a day and draw off any serum that collects.

In streptococcal cases drainage may be very prolonged, but the period may be shortened by treatment with the appropriate vaccine with careful attention to the dosage and the intervals between the doses.

Irrigation is not advised, but after a few days, when the temperature has fallen, the writer has found healing accelerated by allowing the patients, if children, to sit in a boracic bath for some ten or twenty minutes so that they irrigate themselves. This plan is especially useful in children, for it seems to increase the depth of inspiration and aid in expansion of the lung. Careful attention should be directed towards helping lung expansion. Adults must be made to lie on the sound side for some hours each day after the first few days, and they should be given breathing exercises to perform at stated intervals. Children may be allowed to blow bubbles or expand a coloured "air ball." If they are very young the Sylvester method of artificial respiration may be practised very gently once or twice a day.

The patient should remain in bed about a week, that is to say, until the temperature falls and all embarrassment due to alteration in the position of organs or changes in the respiratory conditions have passed away. But they should be got up as soon as possible, for the necessary exertion aids lung expansion. In all cases a period at the seaside greatly helps convalescence.

Throughout the treatment it should be grasped that rapid recovery depends chiefly on the following factors:

1. Recognition of the bacterial cause of the abscess; 2. early evacuation of the abscess; 3. thorough drainage; 4. expansion of the lung; 5. elasticity of the chest wall. It is the aid given by this last in children which makes their convalescence more rapid.

(2) **Double Empyema.**—In these cases the respiratory embarrassment is very great and it is not safe to open both sides of the chest at the same time. A good plan is to aspirate one side of the chest, leave the patient for twelve to twenty-four hours, and then resect a rib and drain on the other side, leaving the side first aspirated for another day, or even longer.

(3) **Empyema Ruptured into a Bronchus.**—The surgeon may wait a few days to see whether all the pus is coughed up, but in most cases it will be found necessary to open and drain the pleural cavity. A troublesome sinus may result from the operation, but the patient is saved the dangers of a continual discharge of pus through the bronchus. Here again it is important to have had a bacteriological examination made so as to aid closure of the sinus by vaccine therapy.

(4) **Localised Empyema.**—It is sometimes difficult to locate the abscess, and often repeated punctures are necessary even when X-rays have indicated a likely spot. When pus is found leave the needle in and resect a piece of rib above it, empty the abscess and drain.

(5) **Failure of an Empyema to Heal.**—*Sinus.*—Here it is important to find the cause and treat it. The causes may be summarised as follows;

1. Inability of the lung to expand from delay in incising the empyema, or from adhesions; 2. Imperfect drainage; 3. Tubercle; 4. Necrosis of rib; 5. Retained tube; 6. Feeble condition of the patient due to prolonged discharge and lardaceous disease.

Should an empyema have persisted for two or three months without healing, the surgeon should decide whether this is due to imperfect drainage or necrosis of a rib, and if he has not had the case under his personal care throughout it is well to make sure that a tube has not receded into the pleural cavity. Careful examination with a probe and finger under an anæsthetic, together with a skiagram, will exclude or discover the presence of a tube or of rib necrosis and will show whether there is a dependent cavity where pus can collect.

When the original opening has been made in the mid-axillary line a probe should be passed down the sinus. If the probe discovers an undrained cavity below or posterior to the opening, make a counter-opening in the most dependent position, then dilate the original opening and pass a large drainage tube right through and stitch it to the skin at each opening. In about ten days the tube is shortened so that it no longer passes through the upper or anterior opening. As a rule, this proceeding results in gradual healing of the sinus.

Sinuses of a similar kind, but which are not clearly due to imperfect drainage, may be treated by the injection of bismuth vaseline paste.[1] (See next article.)

Want of Expansion of the Lung.—Where a cavity remains after the softer parts have yielded as much as possible, it is entirely dependent for its closure upon the ultimate sinking in of the chest wall. These cases are becoming less and less common as the importance of early incision and drainage is recognised and since surgeons have learnt to avoid opening the pleural cavity for tuberculous pleurisy. The writer has only been called upon to treat one case of this kind, and that a tuberculous one.

When the surgeon meets with a case in which closure has not occurred, although it is five or six months or more since the operation, and although good drainage has been maintained throughout, two methods are open to him. These are: (*a*) Thoracoplasty; (*b*) Decortication.

(*a*) *Thoracoplasty.*—Estlander's operation: This is the more common method, but besides being a difficult operation and one of some risk to the patient's life it is not always successful, and should only be undertaken when other means have failed or when the empyema is tuberculous. A skilled anæsthetist should always be obtained for this operation. The sinus is dilated and explored with the finger in order to ascertain the precise extent of the cavity. The outline of the cavity is marked out on the chest wall and a flap of skin muscle raised from the ribs which are to be removed, over the whole area of the cavity.

As a rule, the convexity of the flap should be forwards, but the shape and position of the flap in each case must be decided upon by the operator himself. The important thing is to make the flap raised larger than the cavity in the chest. After raising the flap secure the bleeding vessels. Introduce the finger into the cavity and estimate the amount of each rib to be removed. Do not remove the first rib even if the cavity extends so high; and if possible avoid resection of the second rib. Incise the periosteum along each rib and remove the required amount of each rib subperiosteally, then cut through the periosteum and pleura along the posterior border of the cavity, clipping the vessels as they are divided. The whole of the parietal pleura with its attached periosteum is then rapidly cut away over the whole cavity.

The surgeon now decides whether he will be content with thoracoplasty or whether he will proceed to decortication.

If thoracoplasty only is considered advisable, the cavity is thoroughly cleansed and scraped with gauze dipped into iodoform emulsion. The flap of skin and muscle is then laid over the cavity and should come in contact with the visceral pleura over the whole extent of the old cavity. Unite the skin and muscle edges with interrupted sutures and introduce one or two drainage tubes in the most dependent parts. Should the patient become somewhat collapsed during the earlier stages of the operation it is best to attempt the closure of a part only of the cavity.

Records show that the results of this operation are uncertain and that the most successful cases are those in which the cavity is small and does not reach high up the chest. Frequently, however, much improvement results, for a large part of the cavity may be closed and only a small sinus with scanty discharge may remain.

(*b*) If the surgeon decides upon *Decortication* the thickened layer of pleura covering the lung and binding it down to the vertebral groove is incised cautiously with a knife until the lung tissue is reached along the anterior border and sides of the cavity. The cut edge of the pleura is then seized with forceps and stripped off the lung. This should be done slowly and carefully until the vertebral groove is reached, when the pleura is completely cut away. The operation is completed by suture and drainage as above.

During the operations above described it is advisable to cover those parts which are not actually being manipulated with towels wrung out in hot saline.

(6) **Tuberculous Empyema.**—These cases are not very amenable to treatment, but they illustrate the importance of preliminary puncture with examination of the fluid. If such examination, together with other signs discovered by the physician, point with any certainty to tubercle, opening the pleural cavity should be avoided. Pressure symptoms should be treated by partial aspiration from time to time as required. Whenever aspiration is undertaken it must be with the most careful aseptic precautions, in order to prevent the tuberculous empyema from becoming infected with pyogenic or other micro-organisms.

(7) **Empyema due to Other Causes.**—Empyema may result from perforation of the œsophagus due to ulceration, caused by the

presence of foreign bodies or malignant disease, or from the passage of bougies to complete a diagnosis of malignant stricture of the œsophagus. A liver abscess or a sub-diaphragmatic abscess may sometimes cause empyema. The treatment of such an empyema is conducted on similar lines to those described for liver abscess and sub-diaphragmatic abscess.

H. S. PENDLEBURY.

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[1] Shober, "Bismuth Treatment of Sinuse," British Medical Journal, July 2nd, 1910, II., Epitome, p. 2. Beck, E. G., "Trans. of Sixth Internat. Congress on Tuberculosis," Philad., 1908, II., pp. 219—250.

THE TREATMENT OF FISTULOUS TRACKS IN EMPYEMA BY THE INJECTION OF BISMUTH AND VASELINE.

In a certain number of cases of empyema healing will be incomplete weeks and even months after the operation of re-section of a rib; and fistulous tracks will be found communicating with an abscess cavity within the thorax. Against a condition such as this it may well happen that ordinary methods of treatment are powerless. It is true that sometimes an appropriate autogenous vaccine or the performance of some modification of Estlander's operation will promote healing; but in a certain proportion of cases the result is not so fortunate, and it is then that the following treatment may be found of extreme utility. The essential part of the treatment is to inject into the sinus and its ramifications, with such force as to fill them completely, a mixture of bismuth sub-nitrate and vaseline of such a consistency as to be solid at the body temperature. The following technique will be found to yield satisfactory results. A paste is prepared consisting of 33 per cent. bismuth sub-nitrate, 67 per cent. pure vaseline. The bismuth is intimately mixed with the vaseline at a temperature that is high enough to insure sterilisation of the mixture. This preparation becomes solid when cooled to 98° F.; it is therefore injected at a temperature of 102° F. from a powerful glass or metal syringe which has previously been sterilised by dry heat. Prior to the injection the sinus is rendered as dry as possible, and the surrounding skin is washed with an antiseptic lotion and carefully dried. The injection should be made with considerable force, and should be continued until the patient complains of definite discomfort. On removing the syringe a dry dressing is applied with a firm bandage. In favourable cases the dressing need not be touched for ten days, after which period the sinus will be found to be completely healed. If, however, as not infrequently happens, there is considerable discharge, it is well to repeat the injection every other day till healing takes place, if need be for a period of several weeks.

Since bismuth is opaque to the X-rays, the extent and multiplicity of the fistulous side-tracks in many of the cases can readily be shown by means of an X-ray photograph taken after the injection (Fig. 1). The best results from this treatment are seen in cases of unhealed pleural empyema, but it may be used with advantage in other cases of chronic abscess and sinus formation. It is, however, definitely contra-indicated when there is any suspicion of diseased bone, or where the causative organism is likely to be of very high virulence.

This latter factor does not often enter into the consideration of empyema cases, since the organisms present several weeks after evacuation of the pus are usually of very low virulence. Indeed, the causes of delayed healing are mechanical rather than bacteriological, and therefore the success of this treatment may be explained on the hypothesis that its action is largely mechanical, in that it supplies a ladder or framework for the new-formed connective tissue to travel along, and so facilitates the obliteration of the cavity.

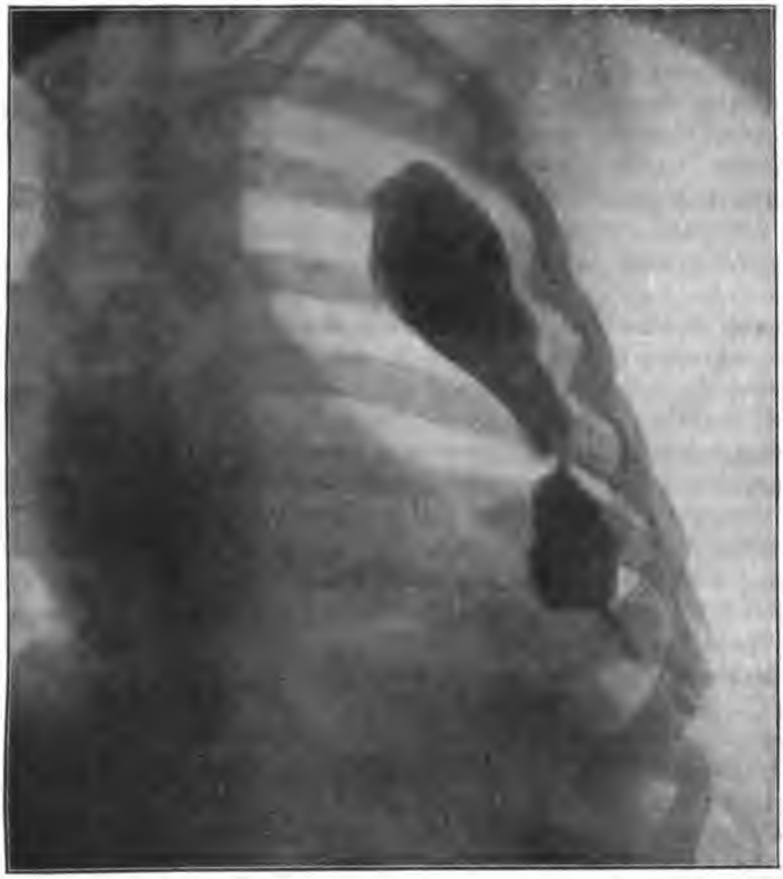


FIG. 1.—Radiograph of an unhealed empyema immediately after injection with bismuth and vaseline. The photograph shows two large cavities connected with each other and with the outside by extremely narrow tracks. Healing took place in one month from the first injection. Five injections were necessary. (By permission of Dr. Cyril Ogle.)

JAMES TORRENS.

REFERENCE.

Beck, Emil., "Archives of the Roentgen Ray," 1908.

PNEUMOTHORAX.

Treatment falls into two stages—the first dealing with the symptoms immediately following the onset; the latter with the effort to close the opening and deal with the effusion, serous or purulent, which may have formed.

The indication in the first stage is to meet the cardiac strain and dilatation of the right heart caused by the sudden loss of respiratory area. Free stimulation is called for by ether and ammonia, either by hypodermic injections of strychnine, or best of all the almost continuous inhalation of oxygen. Where the opening is free no more can be done, but in the valvular type of pneumothorax the excessive pressure of the air within the chest above the ordinary atmospheric pressure, evidenced by increasing dyspnœa, increase in the enlargement of the affected side and increasing displacement of the heart, must be relieved by tapping and removal of the air. Under these conditions it is best to provide permanent exit for the air by leaving the cannula *in situ* in an interspace, secured by a thread passed round the chest, its opening covered by some folds of gauze to act as a filter.

Cough being the chief agent in the production of this excessive pressure, it should be controlled by morphia.

The danger of the first few hours having been met, the treatment of the second stage opens, and will vary according to the condition set up in the pleura.

In the septic group, pneumothorax resulting from gangrene and allied conditions, immediate incision and drainage is required, the invading organisms being so virulent that intense pleurisy and a septic empyema must needs arise at once. The group is recognised by the conditions under which the pneumothorax has occurred, the high pyrexia and the rapid development of pleurisy. The group is, however, a small one, and the mass of cases consists of those in which the invading organisms are less active and the process less intense. If fluid forms at all, which may never occur, it is for long serous and does not necessarily, and then only gradually, become purulent.

Under this head are included the cases of spontaneous pneumothorax in persons in health, in which effusion is rare, and the majority of the tuberculous cases, many of which never advance beyond the stage of serous fluid. In these a waiting policy is best, to allow the opening of the pneumothorax to seal, the first step towards the expansion of the lung and real cure. To this end absolute rest in bed to secure the minimum of activity of the lung must be enforced. The air may be absorbed and the lung expand without the appearance of effusion. Even if fluid collects, provided it is serous, there need be no hurry to intervene unless respiration is embarrassed, as its presence immobilises the lung and will not affect its power of re-expansion later. It must be noted that the use of an aspirator for its removal is quite inadmissible for fear of re-opening the pneumothorax, a syphon trocar or ordinary trocar and cannula being sufficient.

PYOPNEUMOTHORAX.

With the formation of pus the situation alters from the danger of the lung becoming bound down by organising inflammatory products and its re-expansion prevented for ever.

In the past it has been the custom not to drain a pyopneumothorax, but to allow the pus to remain, only withdrawing it at intervals as a measure of relief, the objection to drainage being the uncertainty whether a lung completely collapsed and the seat of a pneumothorax will ever expand sufficiently to close the pleura, the patient being then left with a freely suppurating cavity too large for any surgical procedure to close. Moreover, an extensive Estlander's operation so weakens the support of the working lung as to diminish seriously the respiratory power and to threaten asphyxia.

Though the danger is a real one in the case of a pyopneumothorax of long standing, it does not hold with the same force for early operation before the lung becomes irrecoverably adherent, and the writer would advocate re-section of rib and drainage at an early stage as soon as the fluid shows signs of becoming purulent and before extensive adhesions have formed; done at this time the result has been good. The best policy in cases of this class appears to be to wait and allow the opening to seal; if fluid collects, to ascertain its nature from time to time, and as soon as it shows signs of becoming purulent, to drain.

J. J. PERKINS.

SURGICAL TREATMENT OF PYOPNEUMOTHORAX.

(1) Cases of an entirely tuberculous nature, and in which no pyogenic infection has occurred, are better left untouched. They are usually chronic and often present no very

urgent symptoms. Though incision may at first produce some improvement, it is almost impossible to prevent septic infection, and the chances of the lung expanding to fill the cavity are very remote. If urgent symptoms do appear the pleural cavity should be tapped as occasion arises. Should this course prove unavailing Godlee's plan of substituting boracic solution for the pleural contents and then syphoning off the boracic, carefully avoiding any entry of air, may be tried.

"The patient should be placed on his back close to the edge of the bed, or rather on his side, projecting slightly beyond it. Two perforated needles are inserted into the chest, one into the anterior part, after ascertaining that the lung is not adherent at the point selected for its introduction, and the other at the posterior part of the chest—say, at the eighth or ninth interspace below the angle of the scapula. To each needle is attached a rubber tube. That in connection with the anterior one passes to the bottom of a large bottle containing warm boric acid lotion, which has been prepared with warm sterilised water, temperature 100° F., and to the other needle is attached a tube which is either connected with the aspirator or is allowed to pass into a basin, which is placed on the floor. The fluid is thus allowed to drain from the chest, and its place is taken by the boric acid lotion. When this comes through quite clear the anterior tube may be removed, and then as much as possible of the boric acid lotion is to be evacuated, either by the aspirator or by the syphon action of the posterior tube, as the case may be."

(2) **Pyopneumothorax following Injury** should be treated on the lines of ordinary empyema.

H. S. PENDLEBURY.

PNEUMOKONIOSIS.

Inhalation of dust being the prime factor in the causation of this disease, it is obvious that it is most important that efficient preventive measures should be employed in all those trades in which the worker is subject to any such risk. These include the ventilation of mines by, among other things, the provision of flues through which contaminated air may escape; the removal of dust in workshops by means of fans and down-draughts, and by the frequent sweepings of the floors or even by the sprinkling of them with water during meal times; the employment of automatically-sprayed water when rock-drills are used for boring; the substitution of wet for dry grinding, or the enclosing of the grinding wheel; and the encouragement of the workmen in the habitual use of respirators while at work, to spend as much time in the open air as possible and to keep the windows of their houses open, and, not the least important item, to subject themselves to medical examination at regular intervals.

Directly there is the least suspicion that a person is suffering from the disease, he should, whenever possible, be at once removed from the source of irritation by changing his occupation, preferably for one in the open air. He should be placed under the best possible climatic conditions, namely, a bracing climate in the summer and a warm one in the winter; and such tonics should be exhibited as iron, arsenic, quinine, the hypophosphites, and cod-liver oil, the last mentioned being of especial value. Subcutaneous injections of nucleins have been recommended. The dyspnœa, which is so usual a symptom, may be relieved by ammonia, diffusible stimulants, strychnine and oxygen.

It would seem that the main risks which the patient runs are those of tuberculosis, bronchial catarrh and emphysema. Therefore he should be minutely instructed in regard to all measures which have an influence in preventing these maladies, such as plenty of fresh air night and day, a liberal and varied supply of nourishing food, and the most careful avoidance of exposure to chill and all depressing influences. His medical adviser should be on the look-out for indications of bronchiectasis, so that it may be treated in its earliest stages.

FREDERICK W. PRICE.

PULMONARY ASPERGILLOSIS.

Every workman exposed to the danger of this disease should wear a suitable respirator. The disease being contracted, it is of much importance that the patient should avoid coming into further contact with infected grain, flour or meal; hence, a change of occupation is always advisable. Beyond this, an abundant supply of good air, a generous diet, and such tonics as iron, quinine, and cod-liver oil, are indicated, not only because of their influence upon the disease, but also to counteract the risk of tuberculosis supervening. During periods of pyrexia, rest is advisable. Iodide of potassium and arsenic have a decided effect upon the disease, therefore prolonged courses of these drugs should be administered.

Cough, attacks of asthma, hæmoptysis, and other symptoms or complications should be treated on the lines recommended elsewhere. The presence of abscess or gangrene may call for surgical interference.

The treatment of secondary pulmonary aspergillosis is that of the primary disease.

FREDERICK W. PRICE.

PULMONARY TUBERCULOSIS.

THE PRINCIPLES OF TREATMENT.

In pulmonary tuberculosis, as in every form of infective disease, we have a constant war between the invading micro-organisms and what may be termed comprehensively the defensive forces of the body. The latter are complicated things, and upon their response to the invading organism or its products depends the question of recovery or extension of the disease and eventual death. If there is no response on the part of the defensive forces, or if the response is such that the toxic effect of the bacteria or their products is not neutralised, the inflammatory process continues, and the disease extends, giving rise to general symptoms such as fever, and to results due to local changes, such as cough and expectoration. In treatment, then, we must have two aims; (1) measures which strengthen the defensive forces, and place them in a position of the greatest possible fighting capacity; (2) measures which will limit the absorption into the circulation of the bacteria or their products, or, in other words, limit what is termed auto-inoculation.

The treatment which has been shown by the test of time to fulfil these aims to the greatest extent is Sanatorium treatment together with the administration of tuberculin. Sanatorium treatment does not necessarily mean treatment in a Sanatorium, but it is obvious that any treatment is more likely to be attended by good results if it is carried out in a specially constructed institution conducted by experts in the particular treatment. Again, in pulmonary tuberculosis success or failure depends on the exact regulation of exertion, as will be presently seen, and there are many persons so constituted that they are incapable of grasping the vital necessity of carrying out directions in every detail. Such persons should be sent to a Sanatorium, which in this respect acts as a school, for there every action comes under the *direct* supervision of a medical man. On the other hand, many patients are capable of carrying out the necessary treatment at their own homes under the supervision of their own attendant. Nothing is so hopeful as regards the crusade against the disease, as the excellent results which are being obtained now by means of Sanatorium treatment for the poor in their own homes. Again, circumstances are often such that it is impossible for the patient to go to a Sanatorium. It is, therefore, necessary that every medical man should be fully cognisant of the principles of the necessary treatment. Dr. Lawson has written an article, which immediately follows this, on the details of Sanatorium treatment. Little ingenuity is required to adapt these details to treatment in a patient's own home. I propose, therefore, to confine myself to a short survey of the main principles of treatment.

THE INCREASE OF THE PATIENT'S RESISTANCE.

In our endeavour to increase the fighting capacity of the patient's defensive forces, that is to increase his immunising response, we must do everything we can to protect him from debilitating conditions, and to raise the standard of his health. With regard to the former the chief necessity is the avoidance of fatigue, for fatigue not only makes the defensive forces less capable of response, but, as will be seen presently, the exertion which causes fatigue produces an excessive auto-inoculation, and consequently increases the task of the defensive forces. For the purpose of raising the patient's capacity for an immunising response our most valuable measures, apart from the regulation of the quantity of bacteria or their products absorbed into the circulation which is dealt with below, consist of the constant supply of fresh air, and of a nutritious diet.

The Constant Supply of Fresh Air.—The patient should be bathed in fresh air continuously. If his condition permits he should spend as much of his time as possible out of doors. When indoors his windows should be kept wide open. These requirements are easily met in a private house. The main idea is not what has been called the "hurricane treatment," but really efficient ventilation. There is one exception to the open-air conditions. Patients who have advanced disease complicated by bronchitis, or patients who suffer much from frequent attacks of bronchitis, although the tuberculous process has become arrested, do best in my experience if they are not so rigid in the application of open-air methods. In them the bronchitis must receive the chief consideration, and they suffer from fewer attacks if in bad weather they shut their windows and ventilate their bedrooms by means of a fire. *Wind* must be avoided, as it greatly increases the tendency to cough, and the fatigue of exertion. *Dust*, unless it is infective, does not appear to do great harm, but it may be irritating and increase the cough. In any case the furniture of the patient's room must be such that little dust is made, and that what does collect is easily removed by wet cloths. The question of *climate* is not so important as was thought formerly. The best guide in a particular case is the climate which has previously suited the patient. As a rule, a bracing climate and a dry soil in a spot protected from undue wind, together with a sufficiency of sunshine, will meet all requirements. Certain patients do better in high altitudes than in the low lands, but the reverse is also frequently the case even when there is no cardiac complication. Many statistics show that there is no such thing as a specific climate for pulmonary tuberculosis. Fresh air is the essential thing in climate. Constant medical supervision and careful regulation thereby of the amount of auto-inoculation prescribed is the essential thing in treatment rather than any question of altitude or climate. At the same time, it must be remembered that a change of climate is most beneficial, and there can be no doubt that patients often derive considerable benefit by having an after cure at a high altitude when they leave a Sanatorium, or when the disease has been arrested at home. The question of choice of climate in practice generally narrows down to the choice of a Sanatorium, and here the character and capabilities of the Sanatorium physician should always be the determining factor.

Diet.—Details of this are given in Dr. Lawson's article. Over-feeding is not required. Our aim is to increase gradually the weight, not to make our patients fat. Constant care is required so that the stomach shall not be overloaded and so become dilated and thus lead to gastric disturbance which militates against the chances of recovery. The diet even in febrile cases should consist of solid food, with a slight excess of fattening foods, such as cream, milk, butter, potatoes and farinaceous food. In many instances there is no necessity to give the large quantites of milk which are so commonly prescribed. The *assimilation of the food* is even more important than its character. It is essential that the digestive apparatus should be in a position to respond to the call made on it at a meal. The patient should not be fatigued when he sits down to a meal or his digestion will be impaired. In all cases then the patient should rest alone under open-air conditions for a full hour before luncheon and dinner, doing nothing involving any mental effort. In addition he should sit quietly for a quarter of an hour or twenty minutes after meals.

The administration of Tuberculin.—It is now generally agreed by those who have had sufficient experience of the remedy that tuberculin is most useful in those cases of pulmonary tuberculosis in which auto-inoculation is not excessive, that is in afebrile chronic cases. Not only does it turn the balance in favour of improvement and recovery in many cases, in which ordinary Sanatorium methods have produced little effect, but it is of benefit to those cases in which ordinary methods produce improvement. In these tuberculin is of service in two ways: first it produces more rapid improvement, secondly, relapses are less frequent in the case of patients who have had Sanatorium treatment and adequate tuberculin treatment than they are in the case of patients who have only had Sanatorium treatment. Tuberculin Therapy is not easy, and there is no doubt that it may be productive of great harm or even fatal results in inexperienced or careless hands. Details of the administration of dosage and spacing of doses is given in the article on Tuberculin Therapy in Volume III., but it may be stated here that in all cases in which tuberculin is of service it should be given for not less than a year. Each case must be considered on its merits, but as a general rule it is wise to commence with a minimal dose, and to settle the size of further doses and the spacing of them entirely on the results obtained. In some cases the dose can be rapidly increased, in others we have to proceed very slowly. We aim at producing no reaction, but at the same time try to increase the size of the doses gradually until large doses are taken. Tuberculin is also of service in cases in which there is considerable auto-inoculation, provided that we can control the auto-inoculation to some extent by absolute rest, relief of cough etc., (*see* next paragraph). When auto-inoculation is uncontrollable as in advanced cases in which the constant harassing cough is leading to the frequent absorption of unmeasured doses of the bacteria and their products, tuberculin usually does more harm than good. The following chart shows, however, the good effect of tuberculin in a case of excessive auto-inoculation in which there was no improvement under absolute rest.

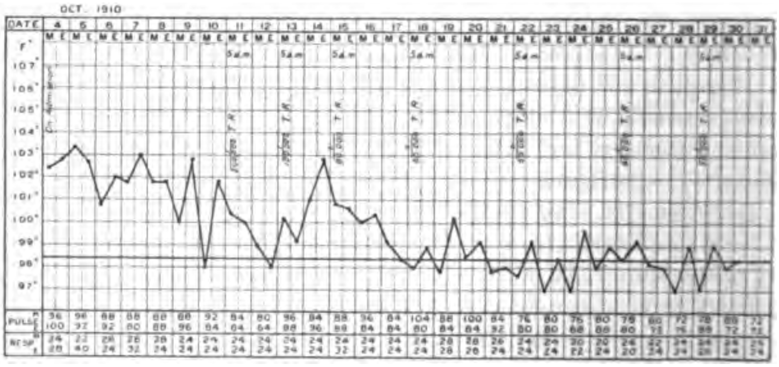


FIG. 1.

The chart on the preceding page is that of a man who was admitted to St. George's Hospital after a month's illness. On admission there was evidence of acute caseous tuberculosis in the upper lobes on both sides. Absolute rest for a week produced little effect. The administration of tuberculin, in this case by the mouth, was followed by a rapid cessation of fever. In a month's time the temperature became normal. The patient was subsequently sent to a Sanatorium and is now at work.

THE REGULATION OF AUTO-INOCULATION.

Brehmer and especially Otto Walther taught us that the successful treatment of pulmonary tuberculosis depended chiefly upon the careful regulation of the rest and exercise indulged in by the patient in healthy surroundings. Our knowledge of Sanatorium treatment is almost entirely based upon their work, but in recent years the researches of Sir Almroth Wright and his pupils, especially Dr. A. C. Inman, have given us a new insight into the pathology of the disease, and hence a clearer understanding of the principles of treatment. Tubercle bacilli and their products produce local inflammation. There is in most cases an immediate response on the part of the local defensive forces of the body. So effective is their response that in the great majority of instances a real cure is effected without the person attacked being conscious of the fact that he has ever contracted the disease. This is proved by the remarkable incidence of healed tuberculosis found at post-mortems after the age of thirty-five, and shows how curable the disease really is. In other cases in which the person attacked is conscious of the fact that he is ill the bacteria or their products are absorbed into the circulation, and produce the symptoms of tuberculous toxæmia. If the dose absorbed is small it acts as a stimulant to the defensive forces of the body which tend then to prevent any extension of the area of disease, and in course of time, as the result of repeated stimulation, to destroy the bacteria and so arrest the disease. If the dose of bacteria or their products however is in excess of the capacity of the defensive forces the bacteria are not kept in check or destroyed, and the disease tends to extend. It follows that in treatment the secret is to endeavour to keep the dose of bacteria and their products, that is to say, the amount of auto-inoculation, within the capacity of the immunising response of the body. The size of the dose absorbed is determined in large part by the amount of blood and lymph which passes through the diseased area in a given time. If there is a larger flow of blood and lymph, a larger quantity of poisonous material will be washed out of the lungs into the general circulation. The amount of blood and lymph which passed through the diseased area depends to a large extent upon the movement of the lungs. The greater the activity of any organ, the greater is the supply of blood and so of lymph. If a man coughs he moves his lung and automatically flushes it with blood. If he walks a mile there is more movement of the lungs, and hence a greater flow of blood and lymph through the diseased area than if he lies in bed. We see then that movement determines the amount of flushing of the lungs; this in turn determines the dose of bacteria and their products which are swept into the general circulation; and this in turn determines the task of the defensive forces of the body. This theory doubtless does not explain everything, for the products of dead cells, and secondary organisms and ferments must play a part, and, in all probability, an important part. Our knowledge of these is at present fragmentary. The above theory does help us greatly, however, in treatment. Its practical application has shown us how true were the principles upon which Otto Walther acted and has enabled us to extend their scope. Whenever a patient exhibits symptoms of toxæmia such as fever, increased rate of pulse, sweating, headache, loss of appetite, decreasing weight or increase of expectoration, we know at once that he is absorbing an excess of bacteria or their products. We know that this is due to excessive movement and that we can only reduce the amount of auto-inoculation to within the capacity of his defensive forces by diminishing his movements.

Whenever there is evidence of excessive absorption of toxic substances, that is, whenever there is evidence of excessive auto-inoculation, the patient must be kept at rest. As will be shown immediately it is not enough to send the patient to bed; rest in bed must be absolute, as in the treatment of typhoid fever. The first thing in any given case of the disease is to ascertain at once the degree of auto-inoculation. In the acute forms, such as acute pneumonic tuberculosis, acute caseating tuberculous pneumonia, there is obvious excessive auto-inocculation. In the less acute forms excessive auto-inoculation is shown by fever above 99° F. when the patient has been resting for half an hour, by increase in the expectoration, or by an increased rate of pulse. In such cases it was the custom to send the patient to bed but not to restrict his movements in bed. Owing to our knowledge now of the effect of movement in inducing auto-inoculation, we find that this amount of rest is insufficient in many cases to reduce the doses of poisonous products absorbed to within the capacity of the defensive forces. We therefore restrict the movements of the patient to the greatest possible degree, and do not allow him to move hand or foot except with the help of a nurse, who treats him as she would a patient suffering from typhoid fever. As will be seen from the subjoined charts absolute rest is much more effective than ordinary rest in bed, often reducing the time to be spent in bed from weeks to days. In a number of cases however absolute rest in itself fails. The cough may be so troublesome that it causes repeated uncontrolled auto-inoculation. It is therefore urgent that everything should be done to diminish the cough if this is possible. Where expectoration is small, the best measure is to use codeine freely. Where the expectoration is profuse the *continuous* use of a Burney Yeo inhaler (with equal quantities of creosote and spirits of chloroform) is sometimes of great service.

Absolute rest is irksome, and if after ten to fourteen days' trial no improvement in the temperature has occurred it is not fair to the patient to continue it. In some cases we have then to consider another possible means of preventing excessive auto-inoculation, namely, by inducing collapse of one lung by the introduction of nitrogen gas. Dr. Pearson and Dr. Lillingston deal with this question in the article on the induction of artificial pneumothorax. The results obtained by this latter method are encouraging, but great care is required in the selection of suitable cases. In those cases in which absolute rest fails, and an artificial pneumothorax cannot be induced, the outlook is unsatisfactory and treatment becomes entirely symptomatic.

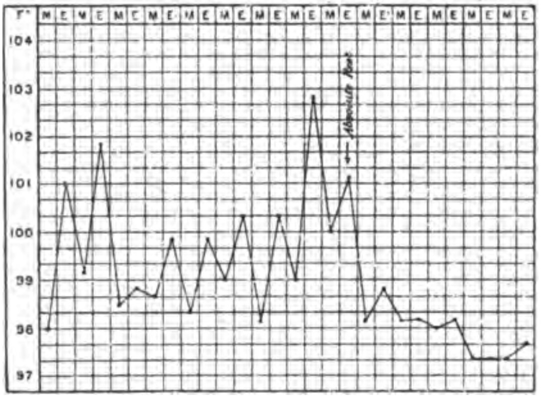


FIG. 2.—Temperature chart showing the effect of absolute rest in a case of febrile tuberculosis in which fever had persisted for seven weeks in spite of rest in bed.

When by one means or another auto-inoculation has been reduced within the limits of the patient's capacity to respond in the formation of anti-bodies we have to consider the question of exercise.

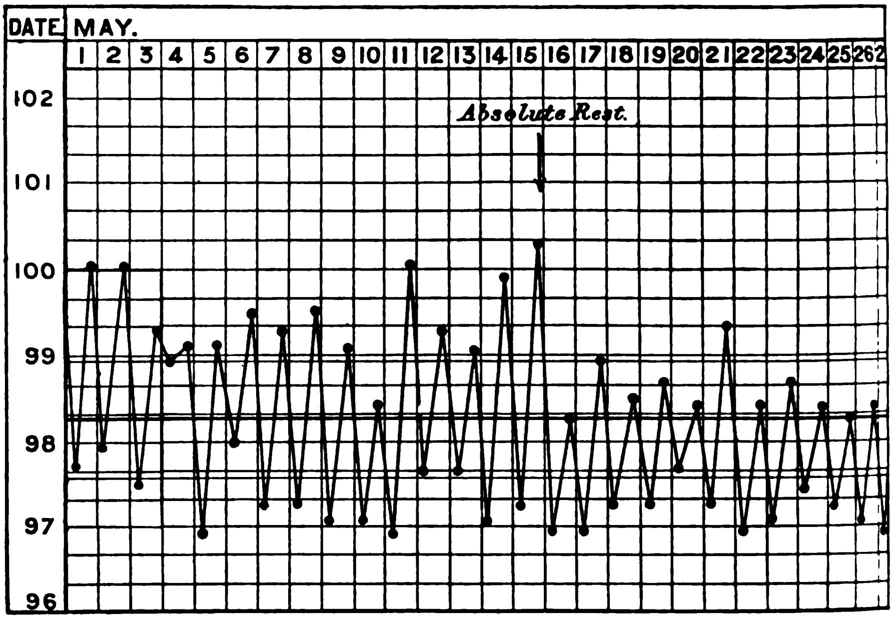


FIG. 3.—Temperature chart showing the effect of absolute rest in a case of advanced pulmonary tuberculosis (five lobes and excavation). In this case the administration of tuberculin lowered the temperature temporarily, but the effect of absolute rest was much more definite.

If we allow the conditions of rest to continue too long the defensive forces become accustomed to the stimulation they are receiving, and a sufficient response is not forthcoming and so no real headway is made. If the stimulant is slightly increased, that is if the amount of auto-inoculation is slightly increased, we get a further response. For this purpose we begin to increase movement. Details of this

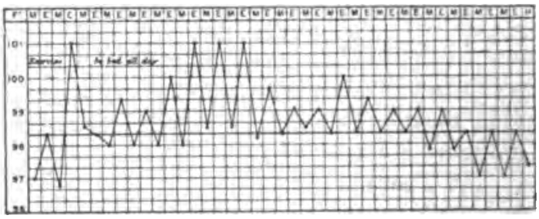


FIG. 4.—Temperature chart showing the the effect of excessive auto-inoculation produced by excessive exercise, and the effect of rest in bed in reducing the fever. It should be noted that the rest was not "absolute," as the patient was allowed to sit up in bed and to go to the lavatory. (Dr. Marcus Paterson.)

are given in Dr. Lawson's article on Sanatorium treatment. The principle which guides us is to increase movement gradually and never to the point of producing a reaction as the result of auto-inoculation. The greater the amount of exertion the patient is trained to take without harm, the greater is his chance of complete recovery. With regard to the kind of exercise or movement to be employed it may be said that although walking exercise is the easiest to control, many observers, and especially Dr. Paterson, who describes his system of graduated exercise in a subsequent article, have shown that practically any form of exertion which can be absolutely controlled, is permissible. Walking, riding, and different forms of labour have all been used with advantage. With regard to games or other forms of exertion the underlying principle is the same. As the patient improves and his condition becomes more stable, games may be permitted, provided that they do not involve too sudden movement or undue exertion, and that the patient is trained to them gradually just as he is trained in walking exercise by a gradual increase in the amount permitted and by careful daily supervision.

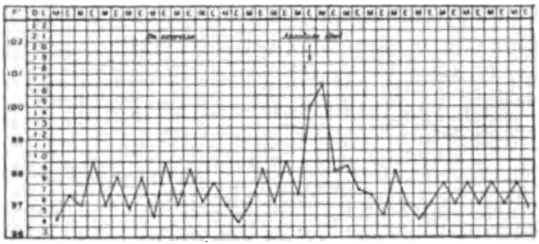


FIG. 5.—Temperature chart showing the effect of excessive auto-inoculation produced by excessive exercise, and the effect of *absolute* rest in bed in reducing the fever. It should be noted that these patients were not allowed to go to the lavatory nor, indeed, to move at all. They were nursed as if they had been suffering from typhoid fever. (Dr. Marcus Paterson.)

OTHER CONSIDERATIONS.

The **after-treatment** of a patient at the end of a course of Sanatorium treatment must depend upon his condition. If there has been no improvement treatment must necessarily be climatic (*see* article on Climatology by Dr. Huggard) and symptomatic. If the disease has become arrested, the patient should continue for two years to make his health the primary consideration, although he is allowed to return to work. He requires to have fresh air as far as he can get it, or rather to avoid impure air and insanitary conditions. He should continue to rest before meals, if possible for half an hour before lunch and a full hour before dinner. He should above all things avoid over-fatigue, as this is the constant source of relapse. The patient must be made to understand that the disease has been arrested but is not cured, and that if he continues to carry out the lessoms he has learnt it will in all probability be cured. If, in addition to the tubercle bacilli and their products further demands are made on his defensive forces by some illness, or other cause, he must take more care than an ordinary person. Thus a feverish cold should be regarded as an important thing; the patient should go to bed and remain there until his defensive forces are again master of the situation. With regard to *occupation or employment* much has been written about the necessity of outdoor employment. Such advice is ideal and seldom practical. As a rule a man is most wisely advised if he returns to an occupation in which his mind is at rest with regard to finance rather than if he makes an attempt to take up something fresh for which he is unsuited in other ways. Many of my patients have returned to occupations which cannot be regarded as being carried out in good conditions without harm, such as that of stockbroker or jobber, Member of the House of Commons, etc.

Secondary Infections with pneumococcus, micrococcus catarrhalis, streptococcus, etc., play an important part. In addition to what has been described above, it may be necessary to make the attempt to increase the patient's resistance in this direction by vaccination with vaccines prepared from the patient's own organisms (*see* Vaccine Therapy, Vol. III.). In most cases, it is best to make the attempt to get the auto-inoculation due to the tubercle bacillus under control in the first place, and then to deal with the secondary organism or organisms.

Reputed Specific Measures.—Every year, one might almost say every week, a new specific treatment for tuberculosis is advertised. At the present moment I know of none which has really stood the test of extensive trial, whether it be Dr. Carl Spengler's I.K., Dioradin, Dr. Marmorek's serum, or Dr. Dewar's method of intravenous injection of iodoform, although from time to time suggestive cases are brought forward.

Prophylaxis consists of using any means of increasing the resistance of the individual by methods known to every medical man, and the avoidance so far as may be possible of exposure to infection.

ARTHUR LATHAM.

THE SANATORIUM TREATMENT OF PULMONARY TUBERCULOSIS.

General Considerations.—In approaching the subject of the treatment of pulmonary tuberculosis it is profitable and convenient to recall in broad outline the pathology of the disease.

A good working conception of pulmonary tuberculosis is one which regards it in the twin aspect of: (1) Local and (2) constitutional disease.

In the sense that the tubercle bacillus sets up local changes in the physical condition of the lung proper—congestion, infiltration, caseation, and ultimate contraction—the disease is of a local character. The alteration in the physical condition, however, is accompanied by the production locally of chemical changes and the formation of toxins. The latter enter the blood-stream and are borne to distant parts. In this way reaching the central nervous system, they there operate upon important nerve centres, and thus give rise to constitutional symptoms. In this sense pulmonary tuberculosis is a constitutional disease. Herein lies the explanation of the classical constitutional symptoms of the malady: stimulation of the sweat centres, exaltation or depression as the case may be of the vasomotor and inhibitory cardiac centres, and interference with the trophic realms, account respectively for the night sweats, brady- and tachycardia, dyspepsia, general wasting, and the various dystrophies of the disease. It is a matter of common observation, upon which there is no longer any room for doubt, that within certain limits, in a very large proportion of all cases of pulmonary tuberculosis, the absorption, if not the production of those toxins, and therefore of the dependent symptoms, can be controlled by appropriate treatment. That treatment consists in making a proper and intelligent use of rest. Exercise increases this auto-inoculation, rest diminishes it. Hence the existence of any of those constitutional symptoms, when persistently present, is an indication for describing complete rest in the recumbent posture so long as that symptom is present. In extreme cases the rest should be as thorough-going and complete as one insists upon in cases of typhoid fever. Where " typhoidal " rest, combined with full diet and careful, painstaking nursing, has been faithfully carried out for many weeks, one has been rewarded on more than one occasion by seeing recovery ultimately take place in cases where in olden and more casual days one had hardly ventured to think it possible.

With a view to exemplifying the actual application of these principles it is proposed to describe in the first place how a day is spent by a patient in a sanatorium, and then to proceed to consider in a more detailed manner those indications for treatment which are called for by those special symptoms and complications which arise in the course of the disease.

Treatment in a sanatorium of an uncomplicated case of early pulmonary tuberculosis which runs a favourable course is divided into two parts or stages: First, there is the pyrexial or bed stage, and secondly the apyrexial or exercise stage.

The Rest Stage.—Every patient on entering a sanatorium is put to bed for a few days to permit of suitable observations being made regarding the behaviour of his pulse and temperature when at rest. When the rectal temperature exceeds 98·4° F. in the morning, or 99·8° F. in the evening, he ought to be kept in bed until both fall below those levels. Two exceptions must be borne in mind. Cases of chronic fibroid disease usually exhibit a temperature which does not at any period of the day reach so high a level as 98·4° F. It may be necessary to keep such patients in bed for other reasons, such as dyspnœa, rapid small-volume pulse or great debility. Again, in an early case, one may find a lower temperature than that indicated above, associated with a rapid running pulse, from eighty beats per minute upwards. Such a case ought to be kept in bed till the pulse-rate has fallen to the vicinity of normal. The temperature in this case is misleading, and in prescribing treatment the physician ought to be guided not by the temperature but by the rate of the pulse.

During the rest stage the routine of a bed-patient's uneventful life in a sanatorium is roughly as follows :

7.45 A.M.—Wakened—and on weighing days, which occurs once a week—weighed. This should be done in the patient's bedroom.

7.50 A.M.—Temperature and pulse are taken by the nurse, and carefully recorded.

8 A.M.—Washed and sponged by the nurse.

8.30 A.M.—Breakfast, consisting of: Porridge and 1 pint of milk; tea or coffee; bread or rolls, 3 oz.; butter, ½ oz. to 1 oz.; fish, 4 oz., or bacon (with or without eggs); cold tongue, sausages, or meat in some form, not less than 3 oz.

12 NOON.—Temperature taken and charted.

12.30 P.M.—Lunch, consisting of: Soup or broth, optional; fish, or meat in some form, not less than 4 oz.; potatoes and one form of vegetable; a carbohydrate pudding, 3 or 4 oz.; cream, 1 oz.; biscuits and cheese; bread, 2 oz.; butter, ¾ oz.; milk, ½ to 1 pint. Fruit or coffee optional.

4.30 P.M.—One cupful of tea and a biscuit.

6 P.M.—Temperature taken and recorded on the chart.

7 P.M.—Dinner, consisting of much the same as lunch, so arranged as to secure variety. It lends variety to introduce an entrée, and on occasions a savory and fruit. The amounts should not be less than at lunch. Alcohol in most cases is undesirable, especially so under forty years of age. In elderly patients, where the habit has been formed, a night-cap of whisky or toddy may successfully combat insomnia when present, and so may be given.

8 P.M.—Sponged by nurse.

9 P.M.—Temperature and pulse having been taken and recorded, the patient soon afterwards settles down to sleep.

Exercise Stage.—A patient usually begins by getting out of bed between 2.30 and 4.30 in the afternoon and resting on a lounge chair in his bedroom. Provided this is not attended by temperature disturbance the same evening or next morning, the time spent out of bed is gradually extended and the daily walking exercise is begun. Commencing with a hundred yards the distance is steadily increased until he may be walking as many as ten miles per day. The exercise patient's routine is as follows:

7.30 A.M.—Patient is wakened. The temperature having been taken and recorded, he adjourns to the bathroom and takes his morning bath. This may be tepid or quite cold, according to what the physician advises.

8.15 A.M.—The physician calls and prescribes the patient's exercise for the day.

8.30 A.M.—Breakfast in the dining-room.

9.30 to 12 NOON.—Walking and climbing exercise.

12 NOON.—The patient returns to his room and records his temperature and passes the next hour in the recumbent posture.

12 to 1 P.M.—Rest in the recumbent posture ; patient not infrequently sleeps.

1 P.M.—Temperature is again taken in order to ascertain if the disturbance caused by the forenoon walk has passed off.

1.15 P.M.—Lunch in the dining-room, then rest on chairs outside the building.

2.30 to 4 P.M.—Further exercise—mild lawn games, such as golf-putting, and croquet or miniature rifle shooting, or gardening, according to what has been prescribed. In suitable cases a drive or motor run of about one to two hours seems to have a good mental effect without doing any harm. But the patient on no account must drive the car.

4 P.M.—Afternoon tea, with one biscuit or thin slice of bread and butter.

4.15 to 5.45 P.M.—Walking exercise as prescribed.

6 to 7 P.M.—Is observed as a rest hour and is passed lying down. Temperature should be taken at the commencement and end of the rest hours.

7.15 P.M.—Dinner in the dining-room.

8 to 9.30 P.M.—Reading, writing or an occasional entertainment.

9.30 P.M.—Patient retires to bed and soon afterwards having recorded the pulse and temperature readings goes to sleep.

The exercise which may be prescribed varies within very wide limits. While one has known patients under treatment walk as many as thirty-five miles in one day, others appear to make perfect recoveries on daily walking exercise which in the aggregate does not exceed three or four miles. No rule can be given. Experience alone enables a physician to determine what amount of exercise in any given case is likely to achieve the best result.

It may not be out of place to note here a development in the prescribing of exercise which has taken place of late and has become a distinctive feature of British institutions. It is to Dr. Paterson, of Frimley, that the credit of conceiving and working out the valuable idea of the working colony belongs, and for particulars regarding it readers are referred to a special article upon that subject. For further information regarding exercise *vide* below under temperature and exercise.

TEMPERATURE AS A GUIDE TO TREATMENT.

What the compass is to the mariner, the sign post to the traveller, so is the temperature record to the sanatorium physician. In it he sees not a feature of the disease calling for treatment on its own account, but he recognises in it an indication of an underlying intoxication. It were as foolish for the pilot to deflect his compass by means of a magnet and then set his course thereby as for the sanatorium physician to reduce artificially the temperature of his patient, and having done so to assure himself that all is then well. Antipyrin, antifebrin, phenacetin, pyramidon and the other coal-tar antipyretic derivatives, which numb the sensitiveness of the temperature centres and in addition depress the action of an already weakened heart, ought not to be employed to combat the fever of pulmonary tuberculosis.

The subject of the temperature in this disease is so large that to deal with it fully within the compass of this article is impossible. Only in so far as it bears a direct relationship to treatment does it come within our purview.

Advantage is taken of the instability and the elasticity of the tuberculous temperature—that is, its tendency to be easily disturbed by extraneous influence, and when so disturbed to remain in the altered condition after the disturbing factor has been removed—to regulate the rest and exercise of the patients.

The Temperature in the Female differs from that of the Male.—Generally it runs about two points higher. The relationship to menstruation is threefold. *Firstly.*—The temperature may be undisturbed by the tidal flow (5 per cent. of cases).

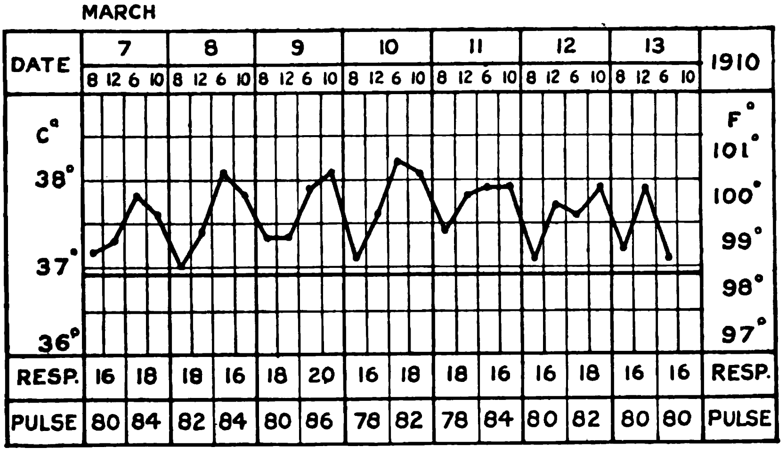


CHART No. 1.

Typical Early Case.—*a.* Continued mild temperature elevation.
b. Accelerated pulse. Treated by rest in bed.

DAILY NOTES. (Chart No. 1.)	
SUNDAY, FORENOON AFTERNOON	Bed.
MONDAY, FORENOON AFTERNOON	Bed.
TUESDAY, FORENOON AFTERNOON	Bed.
WEDNESDAY, FORENOON AFTERNOON	Bed.
THURSDAY, FORENOON AFTERNOON	Bed.
FRIDAY, FORENOON AFTERNOON	Bed.
SATURDAY, FORENOON AFTERNOON	Bed.

Secondly.—No disturbance of temperature may take place until the onset of the menstrual period has occurred, when it may suddenly rise from 1° to 1½° F., generally lapsing to normal within four or five days (10 per cent. of cases). *Thirdly.*—A pre-menstrual gradual rise, commencing from seven to ten days before the appearance of the period and abruptly terminating on the first day of the period, is the rule (Chart No. 2). The behaviour of the temperature is characteristic. It rises about ·1° to ·1½° F. each morning (and also evening), until a range of 99·4° to 100° F. is attained. This occurs in 85 to 90 per cent. of cases. The physician should be on the outlook for this rise of temperature, otherwise he may be misled as to its significance. It furnishes no indication for modifying the treatment, and therefore when it takes place the patient's exercise should not be reduced.

Rectal readings are assumed throughout this article. It is generally admitted that a morning temperature of 98·4° or over and an evening temperature of 100° F. or over indicate rest in bed, and *vice versâ*. To this rule there are numerous exceptions. The most important is that of the adverse temperature. Here the morning temperature may be as high as 104° F., and in the evening

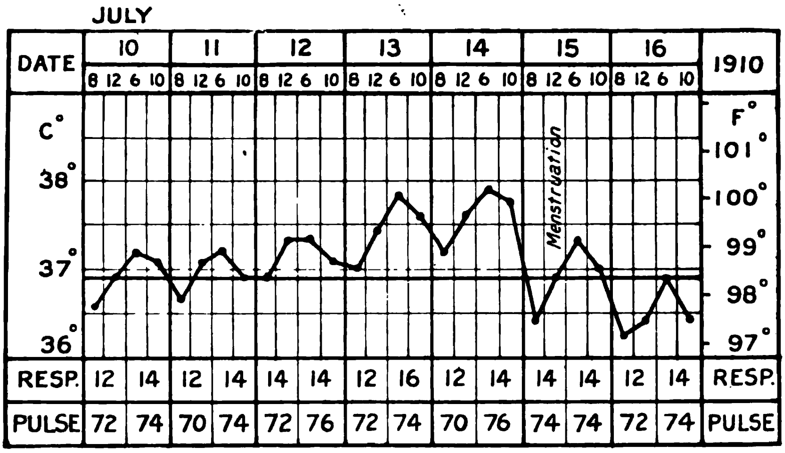


CHART No. 2.

The Usual pre-menstrual rise.—*a.* Exercise is NOT contra-indicated.
b. Rest on the arrival of the period.

Daily Notes. (Chart No. 2.)		
SUNDAY,		
	FORENOON	
	AFTERNOON	
MONDAY,		
	FORENOON	5 miles in 2¼ hours.
	AFTERNOON	2 miles in 1 hour.
TUESDAY,		
	FORENOON	Mountain climb—2 hours.
	AFTERNOON	2 miles.
WEDNESDAY,		
	FORENOON	5 miles in 2¼ hours.
	AFTERNOON	2 miles in 1 hour.
THURSDAY.		
	FORENOON	Mountain climb, 1,000 feet.
	AFTERNOON	2 miles in 1 hour.
FRIDAY,		
	FORENOON AFTERNOON	Rest. Menstruation begins.
SATURDAY,		
	FORENOON AFTERNOON	Optional.

the temperature may be as low as 97·8° F. This form is usually associated with miliary disease (Chart No. 3). The high pulse-rate,

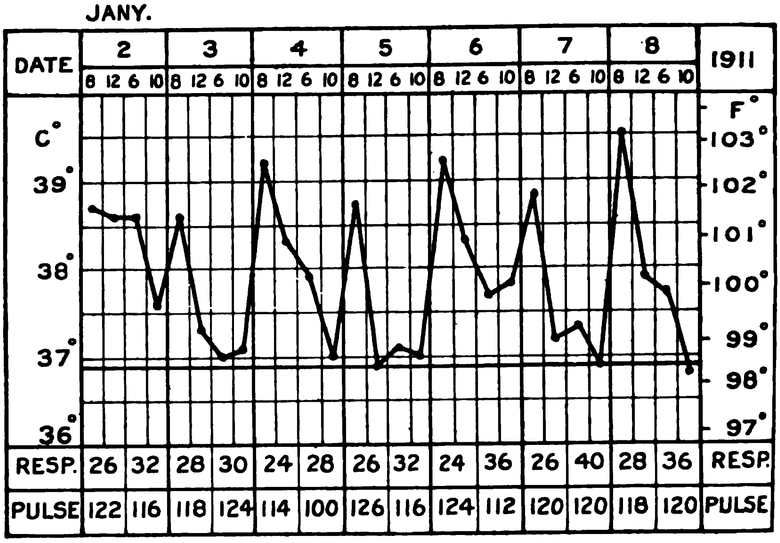


CHART No. 3.

Miliary, typical inverse temperature.—Night sweats and rapid pulse and respiration.

Daily Notes. (Chart No. 3.)	
SUNDAY, FORENOON AFTERNOON	Bed.
MONDAY, FORENOON AFTERNOON	Bed. Night sweats.
TUESDAY, FORENOON AFTERNOON	Bed. Night sweats.
WEDNESDAY, FORENOON AFTERNOON	Bed.
THURSDAY, FORENOON AFTERNOON	Bed. Night sweats.
FRIDAY, FORENOON AFTERNOON	Bed. Night sweats.
SATURDAY, FORENOON AFTERNOON	Bed. Night sweats.

its low tension and the generally serious condition of the patient, should, however, prevent error on the part of the physician in this case.

Exercise and Temperature.—It should be borne in mind that the temperature may be modified by exercise in two ways. *Firstly:* It may be raised. This covers over 90 per cent. of the cases (Chart No. 4). *Secondly:* It may be depressed (Chart No. 5). This occurs in some cases of chronic fibroid disease. The disturbance so caused may or may not quickly pass off after the patient has rested. Advantage is taken of this feature of the temperature in convalescent cases to regulate the exercise prescribed. Where exercise is followed by a rise in temperature to 101° or even 102° F. on a warm day it does not necessarily follow that the limits of benefit or safety have been passed. The vitally important point to ascertain is whether or not the temperature remains in the proximity of the higher level for a period of over forty minutes. If it does so, then rest is indicated during the remainder of the day, and a shorter walk should be prescribed next day. On the other hand, should the disturbance pass off and the temperature return to 98·6° F. within that time then that amount of daily exercise may be continued or even gradually increased. It is thus to the advantage of the patient and physician alike to obtain a daily record of the temperature showing the readings taken immediately after return from exercise and again one hour later.

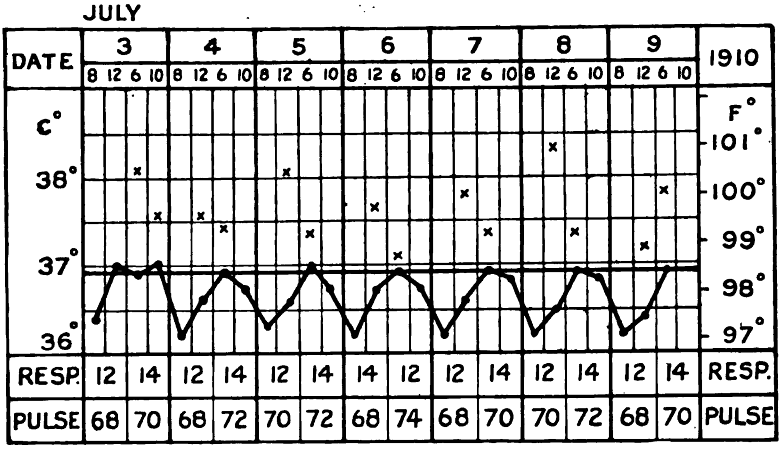
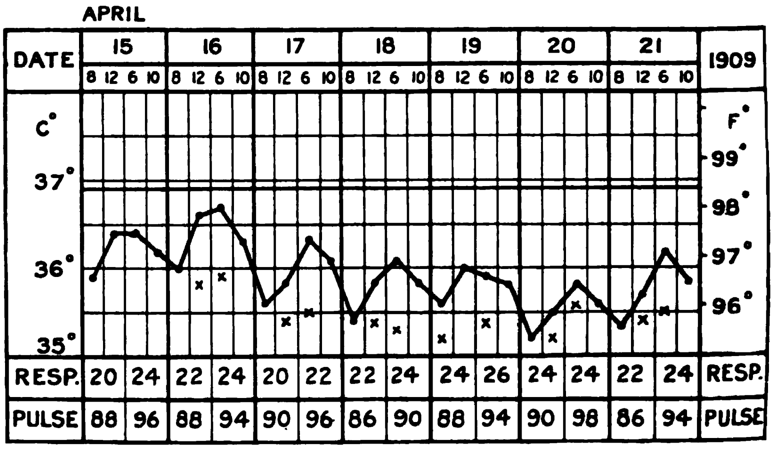


CHART No. 4.—× Indicates temperature immediately after exercise.

Case undergoing arrest.—Exercise raises the temperature, but this effect wears off within 60 minutes of terminating the exercise.

Daily Notes. (Chart No. 4.)

SUNDAY,	
FORENOON AFTERNOON	Optional.
MONDAY,	
FORENOON	8 miles walk.
AFTERNOON	2 „ „
TUESDAY,	
FORENOON	Hill climbing 2½ hours.
AFTERNOON	2 miles walk.
WEDNESDAY,	
FORENOON	7 miles walk.
AFTERNOON	2 „ „
THURSDAY,	
FORENOON	8 miles walk.
AFTERNOON	2 „ „
FRIDAY,	
FORENOON	Hill climbing, 2½ hours.
AFTERNOON	2 miles walk.
SATURDAY,	
FORENOON	7 miles walk.
AFTERNOON	2 „ „



× Indicates temperature taken immediately after exercise.

Chart No. 5.

Typical Chronic Fibroid advanced.
- *a.* Temperature is subnormal (abnormally so).
- *b.* Exercise further depresses the temperature.
- *c.* The respiratory and pulse rate both increased.
- *d.* Small exercise given in such cases.

DAILY NOTES. (Chart No. 5.)

SUNDAY,	
FORENOON AFTERNOON	Rest.
MONDAY,	
FORENOON	1 mile in 30 minutes.
AFTERNOON	½ „ „ 20 „
TUESDAY,	
FORENOON	1 mile in 30 minutes.
AFTERNOON	½ „ „ 20 „
WEDNESDAY,	
FORENOON	1 mile in 30 minutes.
AFTERNOON	½ „ „ 20 „
THURSDAY,	
FORENOON	1¼ mile in 40 minutes.
AFTERNOON	¾ „ „ 35 „
FRIDAY,	
FORENOON	1¼ mile in 40 minutes.
AFTERNOON	¾ „ „ 35 „
SATURDAY,	
FORENOON	1¼ mile in 40 minutes.
AFTERNOON	¾ „ „ 35 „

During the early days of the treatment the increase of exercise ought to be very gradual. Beginning with 100 yards in the forenoon in the corridor, it may be increased at a rate not exceeding 50 yards per day during the first week. The second week finds the patient walking ¼ mile each forenoon; 100 yards may now be allowed during the afternoon, and if all is going well the forenoon exercise may also be increased at the rate of about 100 yards per day. Thus the patient will be walking at the end of the second week about ¾ mile in the morning and ¼ in the afternoon. From that point onwards ¼ mile may be added to the forenoon walk every second day. The bulk of the patient's exercise ought always to be done in the forenoon, and stiff hill climbing when prescribed ought to be confined to this part of the day when the patient is fresh. Many find it advantageous to permit mild lawn games in the afternoon in addition to walking exercise. When such are permitted, it is necessary to keep a careful control both over the nature and amount of exercise given in this way. It should be as specifically and carefully prescribed as the forenoon walking exercise. Then the physician should prescribe, let us say, 18 holes at clock-golf or one game of croquet before tea and 1 mile walking exercise after tea. The games should on no account be left to the patient's discretion; otherwise his keenness may induce him to overdo the exercise taken in this way and so unintentionally invite disaster.

There are two symptoms which may arise in connection with exercise which a physician should always from time to time question the patient closely upon, because the temperature chart will furnish him with no indication of their presence. One is "dyspnœa" coming on with exercise; the other is extreme tiredness or exhaustion appearing during, but as it more frequently does, soon after exercise. The **dyspnœa** points to one of two things: (*a*) *Cardiac compensation being inadequate.* In that case systematic observations of the pulse taken on his return from walking and an hour afterwards will confirm or dispel his suspicions. A maintained acceleration of pulse indicates over-exercise—not necessarily in amount. It usually means the patient has been walking too quickly, and especially so during hill climbing. This ought to be explained to him, and he should be warned accordingly. If it does not pass off soon, then the exercise ought to be reduced in amount, and the patient should so far as possible be restricted to walking on the flat. In older patients a cardiac tonic, containing tinct. digitalis (♏4), liq. strych. (♏3), and tr. capsici (♏½) [U.S.P. tinct. digitalis (♏4), strychnin. hydrochlor. (gr. $\frac{1}{36}$), tinct. capsici (♏¼)], t.d.s., post cib., is sometimes beneficial. (*b*) *Respiratory compensation being deficient.* The establishment of compensatory emphysema in those sound areas which from their position favour its development is a reparative process, and should be carefully watched. It may be defective. This symptom is best treated by continuing the hill climbing, the patient being advised to walk extremely slowly, not to talk whilst climbing and to take frequent rests during the period of exercise. Sometimes this symptom is associated with the presence of large areas of adherent pleura following upon an attack of acute pleurisy. In this case the prognosis is usually good. Time and patience work wonders in such cases.

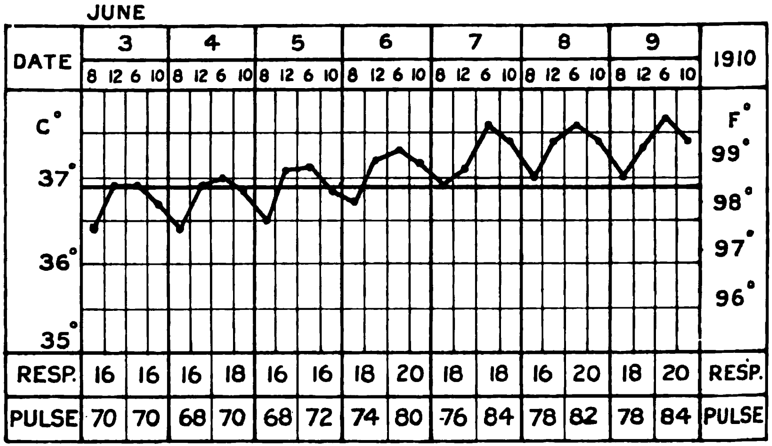
Lassitude or Exhaustion invariably arises from over-exertion, and indicates restriction of exercise. When it appears in a marked degree it is well to put the patient at complete rest for a few days, and then to commence again on a smaller scale. It is usually prudent to inquire closely regarding the nature of the nights the patient is having. Occasionally one discovers the explanation in a mild persistent insomnia. The remedy is, of course, to treat the insomnia. In certain other cases the physician may discover that whilst the prescribed exercises are not exceeded, the time between those set aside for statutory exercise is not being properly employed. Except when engaged in taking the statutory exercises the patient ought to be in the recumbent position in the open air with his feet up. By seeing that this simple direction is observed, the physician may be instrumental in removing this distressing and disheartening symptom.

Exercise after the Administration of Tuberculin.—It has been shown that the administration of tuberculin is followed by a temporary lowering of the resistance, as seen by the fall which takes place in the opsonic index. This period of lower resistance—called the negative phase—may vary in duration from twenty-four hours up to as many days. It does not however usually exceed forty-eight hours; and for the most part is confined to twenty-four hours succeeding the dose. As auto-inoculation is increased by exercise, and it is desirable to restrict the absorption of toxins during this period of subnormal resistance, it is prudent to restrict the exercise, and in difficult cases to abolish it altogether by placing the patient at complete rest during twenty-four hours succeeding its administration. On the second day exercise may be diminished by one-half of what it was previous to the dose; and after that the usual exercise may be resumed.

Massage as a means of keeping up general muscular tone in bed patients, properly and systematically employed, possesses a high value, and more particularly in assisting cases of gastro-intestinal trouble arising from any atonic condition of the stomach and bowel, which may partly be due to withdrawing the patient from an active life.

Gastro-intestinal Temperature.—The temperature of gastro-intestinal intoxication is characteristic. It takes the form of a quick, sharp rise up to any point between 101° or 105° F. Usually it is preceded for a day or two by lack of appetite, and a feeling of slackness—but this is by no means always the case—and symptoms of liver disturbance accompanied by a distinct rigor are common. Bed is not usually indicated. On the contrary, particularly in the liver form, continuance of exercise is an advantage. The condition is well met by advising semi-starvation for two or three days (a little albumin-water or weak beef-tea and rusks may be given every six hours), and the exhibition of an evacuant, of which for all purposes in the majority of instances calomel is the best. It is sometimes found more effective to repeat a small dose of calomel than to give one large dose. Thus $\frac{1}{4}$ gr. to $\frac{1}{2}$ gr. three times daily for two or three days may be more effective than a single dose of 2 or 3 grs. When a patient is on full diet the recurrence of these dyspeptic attacks to a large extent can be prevented by advising him to semi-starve himself one day weekly. One usually advises the setting aside of Sunday for this ascetic observance, as this day in a sanatorium is largely a "Dies Non," so far as routine is concerned.

Increase of Temperature.—The tendency for acute exacerbations to set in from time to time during convalescence is charac-



6. *Typical relapse temperature.*—Morning rise of 1 or 2 points from day to day.
CHART No. 6.

DAILY NOTES. (Chart No. 6.)

SUNDAY,	
FORENOON AFTERNOON	Optional.
MONDAY,	
FORENOON	4 miles in 2 hours.
AFTERNOON	2 " " "
TUESDAY,	
FORENOON	4 miles in 2 hours.
AFTERNOON	2 " " "
WEDNESDAY,	
FORENOON	2 miles in 1 hour.
AFTERNOON	Rest.
THURSDAY,	
FORENOON AFTERNOON	Bed.
FRIDAY,	
FORENOON AFTERNOON	Bed.
SATURDAY,	
FORENOON AFTERNOON	Bed.

teristic of the disease. Happily close observation of the patient's temperature from day to day may enable the physician to recognise this tendency at a point when it can be checked before actual disaster has taken place. Even before the patient is aware that anything is wrong the temperature begins to creep upwards at the rate of about ·1° to ·1½° each morning (Chart No. 6). The appearance presented by the temperature chart in this case very closely resembles that already described under the head of menstrual disturbance. Usually within fourteen days of the first rise of temperature the patient is suddenly observed to be acutely ill: fever with sweating appears, and all the signs of acute trouble which necessitates weeks, it may be months, of rest in bed become manifest. The treatment indicated is complete rest in bed, and this should be insisted upon as soon as the condition is recognised. It is a matter of vital importance to the patient that the physician take a very strong line at this juncture. On no account should he yield to the appeals of the patient or his friends to delay doing so.

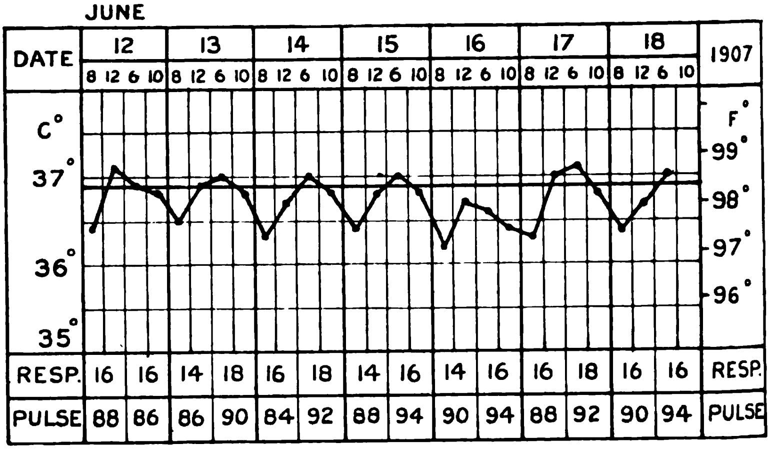
The Temperature in Tuberculin Therapy.—It has been shown by Latham that in man there exists a striking relationship, and that an inverse one, between the opsonic index and the temperature curves of a patient who is suffering from pulmonary tuberculosis. This observation is of value in tuberculin therapy, for as a rise in temperature corresponds to a negative phase, it has become possible to employ the temperature readings in determining the time and dose of the tuberculin administrations. (*See* Tuberculin Therapy, Vol. III.)

Post-hæmorrhagic Rise of Temperature.—This may take place within three days of the occurrence of hæmoptysis (mechanical form), or at the end of the fourth or fifth week (extension form). For particulars, *see* Hæmoptysis below.

The Effect of the Mind on the Temperature.—Mental shock or anxiety may disturb the temperature. It is frequently advisable to remove a patient's chart from his room, and keep him in entire ignorance of the state of his temperature in order to counteract a tendency to develop a morbid interest in the variations of his temperature. Such a state of mind exerts a prejudicial influence, not only upon the temperature readings, but upon the general progress of the patient.

THE PULSE-RATE AS A GUIDE TO TREATMENT.

A careful record of the morning and evening pulse-rate ought to be kept during at least the first two or three weeks of the patient's



7. *Pulse* rate here, notwithstanding low temperature indicates “ Bed.” Note patient put to bed early.

CHART No. 7.

DAILY NOTES. (Chart No. 7.)

SUNDAY, FORENOON AFTERNOON	Bed.
MONDAY, FORENOON AFTERNOON	Bed.
TUESDAY, FORENOON AFTERNOON	Bed.
WEDNESDAY, FORENOON AFTERNOON	Bed.
THURSDAY, FORENOON AFTERNOON	Bed.
FRIDAY, FORENOON AFTERNOON	Bed.
SATURDAY, FORENOON AFTERNOON	Bed.

sanatorium life. To omit pulse observations is a bad practice, and on some occasions must lead to grave errors in treatment being made. The particular toxin or toxins which tend to accelerate the pulse-rate seem to be of not less importance than those which operate upon the temperature. Usually, a low temperature reading is accompanied by a normal pulse-rate; but it is not always the case. Not infrequently we find no evidence of absorption in the temperature, and at the same time when the patient is at rest the pulse may be running from 80 to 90 every morning (Chart No. 7). It is imperative that the patient be kept in bed so long as that condition is present, provided, of course, it does not represent. merely a neurotic pulse. If this is not done, in a very large proportion of such cases the outcome of treatment will be unfavourable. The pulse-rate falls slowly, and it is no uncommon experience for the patient, whose temperature during all that time may be normal, to be obliged to remain in bed for a period of two or three months before the pulse-rate settles. When it does fall our experience of these cases is that the patients invariably get well. Unlike Bodington, who strongly advocated the continued use of small doses of morphia over a period of weeks or months, the writer has not found digitalis or any of the opium alkaloids of any lasting benefit in controlling the pulse-rate in these cases.

COMMON SYMPTOMS AND THEIR TREATMENT.

Sweating, if it fails to yield to treatment, is a highly unfavourable element in prognosis. It is characteristic of the sweating of pulmonary tuberculosis that it takes place during sleep, whether the sleep be that of the usual night rest or the casual sleep which may come on after a meal during the day. It has been shown by Miller, of Glasgow, that tuberculo-opsonic substances are excreted by the sweat. On this account, as well as on account of their debilitating effect on the system, an effort ought to be made to control night sweats. Usually they disappear within a week of the patient adopting open-air lines of treatment. When they persist beyond that time they not infrequently prove intractable, although in a number of cases they yield to tuberculin therapy. Apart from the latter, no advance has been made in the time-honoured treatment of exhibiting atropine ($\frac{1}{200}$ to $\frac{1}{100}$ gr.), combined with hydropathic measures. The patient ought to be sponged with tepid water containing vinegar or eau de Cologne, or acetic acid, or rock salts at bedtime. In order to remove the deliquescent salts which are excreted in the sweat, and which lead to the subsequent feeling of clamminess and risk of chill, he ought to be similarly sponged on waking. Dusting powders of talcum with tannoform or salicylic acid in the hands of Fraenkel are said to have afforded a modified measure of amelioration of this weakening and distressing symptom. If the patient is awake the administration of $\frac{1}{2}$ pint of warm milk containing $\frac{1}{2}$ oz. of brandy has been known to interfere with the onset of this type of sweating. Other remedies useful in more obstinate cases are agaricin (gr. $\frac{1}{12}$, in pill form), picrotoxin ($\frac{1}{60}$ gr., in pill), and mag. oxide (gr. 3 to gr. 5, also in pill form). These should be given about two hours before the sweating is expected to appear. Owing to its action in causing dryness of the throat and aggravating cough, belladonna should be avoided.

Cough is by no means a constant symptom of pulmonary tuberculosis; nor is it in any sense proportionate to the amount of damage or the acuteness of the process in the diseased lung. One has seen a case run a rapidly fatal course without this symptom ever having attracted attention. On the other hand, in some early cases of the disease cough is the outstanding symptom which leads the patient to seek advice. But whatever the cause, cough in itself is in the vast majority of instances undesirable, in so far as it is more likely to do harm than good. The principal indictment against cough is, generally, that it exhausts the patient's strength, and locally that by inducing aspiration of infective material it tends to promote the spread of the disease. The causes of coughing are many and varied. The success or failure effectively to treat cough in any particular case will to a very large extent depend upon the physician having solved the difficulty of discovering the cause underlying the symptom and directing his energies towards dealing with it.

It is convenient to divide the causes which may give rise to cough into three groups, respectively: (1) Extra-pulmonary, (2) intermediate, (3) intra-pulmonary.

Extra-pulmonary Cough.—The first to attract attention is the *mental cough.* In many patients coughing is largely a matter of habit. It is a striking feature of sanatorium experience that rarely indeed does the sound of a cough ever invade the peace of the dining-room, and yet many of the patients who dine there cough at other times. The explanation lies in the fact that coughing in the dining-room, being considered bad form, these patients exercise a wholesome restraint upon a habit which is wholly controllable, and their coughs are never heard. The physician should early impress upon his patient the fact that, if at all, only at certain times is it necessary to cough. Those times of coughing, like our times of eating, are morning and evening, and in some cases also about mid-day.

Skin Cough.—When a person enters a cold bath the rate of breathing is accelerated. If that person is a consumptive, coughing is usually induced. The induction of cough reflexly through the skin is not uncommon where patients in their endeavour to harden themselves quickly do not wear adequate clothing. In the changeable climate of our country the underclothing should be sufficiently warm to reduce the untoward effect of those sudden climatic changes to a minimum.

Ear and Nose Cough.—Those parts ought always to be carefully examined where the cause of cough is not obvious. If the nasal channels are not properly patent they ought to be rendered so by the local application of astringents (*e.g.*, tannic acid, plasmonasal argyrol), or by operation if necessary. It is of the highest importance not only to remove a source of reflex irritation in this region inducing cough, but also to favour the practice of nose breathing in the interests of the lungs.

Throat Coughs.—*Chronic Pharyngeal Catarrh* is a common cause of cough. In the case of the smoker who has been indulging to excess, it usually suffices to restrict or forbid the use of tobacco for two or three months. When the condition has been produced by causes which, it may be, are no longer operative, local treatment is called for. It may be found advantageous to paint the pharynx night and morning with the following: ℞. Pot. Iodi., gr. 10; Tr. Iodi., Glycerini āā ℥ss. Apply to throat as directed. If improvement does not take place, then a more stringent solution is called for. Thus: Argent. Nit., gr. 10 to 11; Aq. destillat. ℥j. Sig.: Paint once daily. Failing this the thermo-cautery has its uses and advantages.

In the milder forms of *sub-acute pharyngitis* it usually suffices to paint with glycerine of tannic acid or an aqueous saturated solution of alum night and morning. If the condition is associated with copious secretion from the naso-pharyngeal region, the condition is most effectively dealt with by the employment of the following: ℞. Sodii Chloridi, gr. 10; Sod. Biboratis, gr. 20; Sod. Bicarb., ʒss; Aq. ad ℥j. Sig.: One teaspoonful to 1 oz. of water. Use with a glaseptic douche (P. D. & Co.) six-hourly.

Acute Pharyngeal Catarrh does not usually last long, and may be efficiently treated by a solution such as this used in the form of a gargle: ℞. Pot. Chloratis, ʒj; Acid. Carbolici, gr. 40; Tinct. Lavand. Co., ℥ss; Glycerini, ℥ss; Aq., ℥vj. Sig.: One tablespoonful in half a tumblerful of warm water; the gargle to be used three or four times daily. Or ℞. Plasmo Nasal. Sig.: One tabloid in 1 oz. of water. The gargle six-hourly.

If a spray is preferred, then the following prescription of Babcock's may prove useful: ℞. Mentholis, gr. 20; Camphoræ, gr. 5; Eucalyptolis, gtt. 4; Acid. Carbolici, gr. 6; Liquor. Albolene or Glymol, ℥ij. Sig.: Use the atomiser three or four times daily.

Laryngeal Cough (*vide* special article on Tuberculous Laryngitis, Vol. III.).

Stomach Cough.—This likewise is a reflex cough, and owes its existence to a large extent to the proximity of the emetic and respiratory centres in the medulla. The irritating cough coming on after meals is sometimes due to the presence of small particles of food remaining about the back of the throat. When this is the case it can be reduced by the patient washing out the mouth and cleaning the teeth after each meal with odol or listerine and water (ʒss in ℥ij water).

In other cases the reflex stimulus is undoubtedly conveyed from the lining of the stomach by the terminal filaments of the vagus. The treatment in this case is for the patient immediately after each meal to place himself in the semi-recumbent posture from half an hour to an hour after its completion. If this fails, then a small dose of heroin (gr. $\frac{1}{12}$) in tabloid or fluid form ought to be taken immediately before the meal. This is frequently a strikingly successful measure, and is believed to owe its efficiency to its influence in lowering the sensitiveness of the reflex mechanism involved.

Intermediate Cause of Cough.—In so far as the *pleura* is in touch with the lung and the surrounding body it occupies an intermediate position. The short, dry hacking cough of an inflamed pleura is characteristic. It is too shallow usually to induce expectoration. If in the upper part of the chest, the treatment consists in counter-irritation applied locally, and small doses (gr. $\frac{1}{12}$th to $\frac{1}{6}$th) of heroin given internally. A mixture containing equal parts of the liniment and tincture of iodine painted over the part at intervals of one or two days may be used; or if local pain is also present, a hot stupe containing ʒj of turpentine or ʒj of liniment of chloroform. Acetic acid (Coutts), firmly applied by a sponge brush, has achieved striking success as a remedy in such cases in the writer's hands. When the part of the pleura affected is low down in the chest nothing gives so much relief as strapping the affected side. It is an important practical point that the ends of the strapping should pass the middle line of the body both in front and behind. The irritating *dry cough of night time,* usually spasmodic, and resembling asthma, is believed to be referable to the pleura. Untreated, it may keep the patient awake night after night, and thus exert a prejudicial effect upon his health. For this particular type of cough one of two drugs is efficacious above all others. These are codeine and heroin. Either may be given in pill or in fluid form, the dose being $\frac{1}{8}$th grain. Syr. of codeine, in 1 drachm dose [U.S.P. codein. phosph., gr. $\frac{1}{4}$], is a convenient and efficacious form of administering the former. This initial dose, if not effective, may be followed in the cases of both drugs by $\frac{1}{12}$th grain by mouth every three or four hours until relief is afforded. Given hypodermically, the action of heroin is even more reliable; exhibited in this manner $\frac{1}{12}$th grain usually suffices. Bromidia, 30 min.; antikamnia, 5 to 10 gr.; syr. chlor. hyd., 1 drachm [U.S.P. chloral. hydrat., gr. 10], all have their advocates, but in the writer's hands have not achieved the success of heroin or codeine.

Intra-pulmonary Cough.—Coughs caused by intra-pulmonary conditions (which include coughs of bronchial origin) differ from those already considered, in that they owe their existence to an effort on the part of nature to expel a foreign body—namely, sputum, from the lung. As it is desirable that the lung should be relieved of this foreign matter, the physician ought not to endeavour by the exhibition of soothing tinctures to discourage this perfectly natural method of evacuating the obstructed air channels. On the contrary, it is his duty usually to encourage this type of cough, and so promote the clearing-out process. He may help the patient considerably by guiding and assisting the evacuant process at the proper time. This type of cough has been called the "effective cough," from the fact that it usually effectively achieves a good purpose in clearing the bronchial tubes. The effective cough which occurs in the morning, and is accompanied by a large amount of sputum, is associated with (a) bronchitis, (b) bronchiectasis, (c) cavity, (d) diffuse caseation. A glass of warm milk on waking, followed by a dose of one of the following mixtures in warm water, enables the patient to hasten the process of evacuating the tubes and so lessen the duration of the coughing period. The tubes having been substantially emptied, the cough disappears. ℞. Spirit. Ammon. Aromat., ♏10; Pot. Bicarb., gr. 15; Spirit. Ætheris Nitrosi, ♏10; Aq. Anisi, ʒss. Sig.: In half a tumblerful of hot water night and morning. ℞. Sodii Bicarb., gr. 10; Sodii Chloridi, gr. 5; Ammon. Carb., gr. 3; Tinct. Chloroformi Co., ♏10; Aq. ad ʒj. Sig.: In $\frac{1}{4}$ pint of warm water night and morning. ℞. Ammon. Carb., gr. 1; Liquor. Senegæ Conc., ♏6;

Tinct. Scillæ, ♏15; Syr. Tolutanus, ʒss; Tinct. Camph. Co., ♏4 [U.S.P. ℞. Ammon. Carb., gr. 1; Fluid-extracti Senegæ, ♏3; Tinct. Scillæ āā ʒss; Syr. Tolutan., ʒss; Tinct. Opii Camphoratæ, ♏4]. Sig.: In a breakfastcupful of hot water night and morning.

Although it is doubtful if any form of inhalation is capable of killing bacilli *in situ*, or even of exerting a modified germicidal action, clinical experience has accorded a value to inhalations as a means of relieving and combating debilitating and irritating cough. Inhalations are of three kinds; (1) *Air*, (2) *dry medicated*, (3) *moist medicated.*

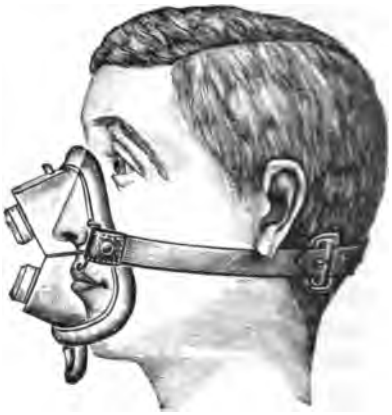


FIG. No. 1.

1. *Air.—Kuhn's mask* (*vide* Fig. 1), as supplied by Martindale, of London, with full instructions for use, is of great value in many cases. It claims to apply the principles of Bier's passive congestion treatment to the lungs, and one's experience leads one to recommend it strongly in difficult cases.

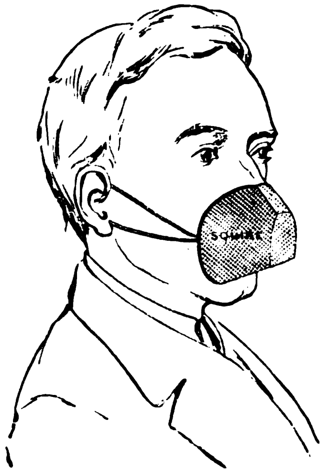


FIG. No. 2.

2. *Dry Inhalers*.—One of the best and simplest is Squires (Fig. 2). Useful formulæ to be used with it are as follows: ℞. Mentholis, Oleii Eucalypti, āā ʒjss. ℞. Creosoti (beechwood), Sp. Chloroformi, Spirit. Rectific, āā ʒjss.

In many cases it is sufficient to inhale five to ten drops of these solutions for short periods three or four times a day. Where the cough is very troublesome and accompanied by profuse expectoration, the relief afforded varies with the length of inhalation, and in such cases it is advisable to prescribe continuous inhalation night and day, as recommended by Dr. David Lees.

The above forms of inhalation can be suitably used in association with open-air methods of treatment.

An objection to the employment of (3) *warm moist inhalers* in association with open-air treatment is that with the patient continually exposed to cold air the liability to acute catarrh (or common cold) seems to be increased by the action of the steam. In advanced cases, where open-air conditions have to be modified owing to the accompanying bronchitis, their use is sometimes of value.

Intra-tracheal Injections, where cavity or chronic bronchitis or bronchiectasis exist as the basis of the cough, are of great value. They should be given not less than three times weekly, and to begin with are best administered daily. One formula has proved more useful than others in the writer's hands, namely: ℞. Mentholis, 10 parts; Creosoti, 2 parts; Olei Olivæ, 88 parts. ʒj to be injected by means of a tracheal syringe as directed.

Izal has its advocates, but does not appear to be so easily borne by the patient as those above.

The more offensive forms of expectoration associated with chronic long-standing bronchiectasis are best treated by the **creosote vapour bath**, as recommended by Dr Arnold Chaplin in 1895, and subsequently adopted at Brompton Hospital. A quantity of ordinary commercial creosote is poured into a metal saucer placed in a ringed iron tripod, and the saucer heated by a spirit-lamp placed beneath it. All apertures in the room having previously been closed up, the patient to commence with should sit in the room whilst this vapour is being given off for a period of fifteen or twenty minutes on alternate days. As the patient becomes accustomed to the experience the duration of the session and frequency of the baths is gradually increased until he is having a daily bath lasting from sixty to ninety minutes. The treatment should be persevered with for a period of three or four months. Owing to the pungency of the vapour it is well for the patient to protect his eyes by closely fitting goggles, and also to see that plugs of cotton-wool are inserted in the nostrils. The effect of the treatment is to cause free evacuation of the sputum, and ultimately to a very great extent diminish its production.

Insomnia.—Insomnia is common, but presents no particular feature in association with pulmonary tuberculosis. For its treatment reference may be made to the special article on Insomnia in Vol. II.

Anæmia.—Anæmia is commonly found in the early stages of the disease. It does not usually call for special treatment. With rest in bed, combined with a full mixed diet containing an excess of milk and butter, it usually quickly disappears. Should it fail to do so, then the ordinary treatment of anæmia should be adopted.

Gastric Dilatation.—Atonic gastric dilatation is common. It is of the utmost importance that it should be dealt with, as on the patient's ability to absorb food depends his main chance of recovery. Massage should be administered daily. Fluids ought to be largely removed from the dietary. Even milk should not be given in greater amount than 1 to 1½ pints daily. Soups, tea and coffee are contra-indicated. Scraped raw meat sandwiches, 6 to 8 oz. daily, along with Plasmon biscuits, are highly nutritive and are easily absorbed. A certain number of cases yield to this combination of massage and dietetic treatment. The majority, however, eventually require systematic lavage. Boric acid (½ oz. to the pint) or Condy's fluid (port wine colour) have, in the writer's experience, yielded the best results. Where the lung disease is not far advanced a good result is invariably attained by this method. It may be necessary to keep up the systematic lavage for several months—at first daily, later two or three times per week.

Failing relief by this means, gastro-enterostomy should receive careful consideration. In one case which passed through the writer's hands the patient not only completely recovered the effects of the operation, but he afterwards gained over 40 lbs. in weight, and a somewhat extensive pulmonary lesion quite cleared up. He is now at full work, and appears to be strong and well. Another case, presenting many features in common with this patient, at present under observation, bids fair to make an equally satisfactory recovery. The operation in this case was advised largely in the spirit of a forlorn hope.

Hæmoptysis.—Apart from overwhelming hæmoptysis, which is instantly fatal, and in the presence of which physician and friends are alike powerless, cases of pulmonary hæmorrhage may fall under one of three heads, according to the degree of severity: (1) Mild; (2) Moderate; (3) Severe.

(1) *Mild hæmoptysis.*—These cases vary between those which present merely stained sputum up to those in which about 1 oz. of pure blood is coughed up. It is well to eliminate these spurious cases in which the bloodstain has come from a small oozing vessel in the throat, or a mild case of lingual varix or small nasal polypus, or a condition of spongy gums. A diagnostic point of value in such cases is this, that close inspection of the expectoration usually shows the streaking to be on the surface of the expectorated material and not evenly distributed through the substance of the sputum,

as one finds in those of lung origin. Moreover, careful inspection of the mouth and gums, and of the larynx by means of the laryngoscope, sometimes reveals the bleeding point. When discovered, the treatment consists in touching the part with a probe on which has been fused a little silver nitrate, or alternatively by applying to it the point of a small thermo-cautery. When the case is one of true hæmoptysis there is a danger of treating the case too seriously. The occasions in which these slight forms prove to be the procursors of serious attacks are so extremely rare that in prescribing treatment one may leave that possibility entirely out of count—excepting always those instances where one's previous experience of the particular patient furnishes good ground for doing otherwise. In the absence of fever and general constitutional disturbance it is sufficient to administer to the patient a mild nerve sedative, such as heroin hydrochlor. ($\frac{1}{8}$th grain, followed by $\frac{1}{12}$th every six hours); a mild evacuant, such as laxoin (gr. 2) or calomel (gr. 2), and cold milk with or without soda-water, four-hourly for twenty-four hours. At the end of that time staining has usually disappeared and the patient may then be allowed out of bed and permitted gradually to resume his ordinary routine. In this way without incurring undue risk a satisfactory mental state is maintained, and the onset of depression, in itself harmful and so frequently associated with the occurrence of hæmoptysis, is avoided.

(2) *Moderate hæmoptysis.*—Under this heading falls the vast majority of cases with which the physician is called upon to deal. And here it is convenient to refer to those broad principles which should be kept in view and should regulate the treatment of all cases of hæmoptysis. These fall under three headings: (*a*) Mechanical; (*b*) Mental; (*c*) Cardio-vascular.

(*a*) The escape of a quantity of blood into the bronchial vessels may be followed by the setting up of distal infection of a tuberculous or pneumonic nature: (i.) in the same lung; (ii.) in the other lung. If the site of the hæmoptysis can be ascertained with a view to preventing such distal infection the patient should at once be placed on the affected side. Where that knowledge is not available, for instance in the case of extensive bilateral disease, dorsal decubitus is indicated. It may be in spite of treatment that the hæmorrhage persists or continues to recur in large amounts at short intervals. Under these circumstances the patient should be propped up in bed in the sitting posture, and kept in that position for twenty-four or thirty-six hours according to circumstances. Particularly in bleeding from apical cavities has one seen the adoption of this measure followed by a cessation of the bleeding. In all probability this acts by calling the law of gravity into force and so diminishing the blood supply to the highest parts of the pulmonary circulation.

(*b*) The appearance of blood operates upon different persons in different ways. In many cases it has a terrifying effect, and in all cases it excites the emotions of apprehension and fear. The effect of these emotions is to increase the rate of the heart's action, and to determine the onset of a greater or less degree of insomnia. It is the physician's duty to combat these tendencies. If he enjoys the patient's full confidence much may be accomplished by carefully reassuring him that all will be well. This measure might be supplemented by the exhibition of a sedative, in the first instance given hypodermically and later on repeated orally. The best drug for all purposes is heroin, it possessing the solid advantage over morphia of controlling instead of exciting headache and vomiting, and its efficiency in composing the patient is not appreciably less than that of morphia and opium. Heroin hydrochlor. ($\frac{1}{8}$th gr.) ought to be administered hypodermically at once, and later on $\frac{1}{12}$th dose, either in tabloid form or in aqueous solution and flavoured with tinct. aurantii, should be given four-hourly for the first twenty-four hours, and then six-hourly during the second day. Personally the writer does not use morphia now in these cases. Theoretical contra-indications notwithstanding, experience has shown an ice bag over the heart to be helpful. If the insomnia in the second and third nights after the attack has taken place should prove troublesome, bromidia (1 drachm) or sulphonal (15 gr.) combined with ammonium bromide (15 gr.), or veronal (8 gr.), or nepenthe (30 min.), or dionin ($\frac{1}{4}$ to $\frac{1}{2}$ gr.) either alone or combined with veronal (7 gr.), may be given with advantage. Trional and paraldehyde the writer has found quite unreliable, acting brilliantly in some cases and completely failing in others. The beneficial effect of cloths soaked in cold water, or an evaporating solution, such as eau de Cologne, wrapped round the forehead, should be borne in mind.

(*c*) Assuming the cardiac indications have been already met, the vascular and blood problem now calls for consideration. The indications are: to lower the tension in the pulmonary circulation, and to favour the formation of a clot at the bleeding point. Let it be at once made clear that the practice of giving drugs possessing a general vaso-constrictor action which for so long enjoyed favour can be no longer defended. One refers to such drugs as ergot, adrenalin, lead acetate, etc. Apart from the significant facts that none of these exert a specific action upon the pulmonary vessels, and that even if they possessed such a selective action, they are not likely to exert it upon a vessel whose walls are atheromatous and whose muscular and elastic fibres have already become disorganised, they are then much more likely to promote a harmful than a beneficent action. For by contracting vessels in other parts of the body they raise the tension in the intrapulmonary vessels and increase rather than diminish the chance of further hæmoptysis taking place at the bleeding point. It is obvious then that the indications are to exhibit drugs exerting a dilating rather than a constricting action on the vessels, and those are best found in the nitrite series. An excellent practice in cases of profuse hæmoptysis is at the earliest moment to break a capsule containing amyl nitrite (5 m.) in a handkerchief, and to place it over the patient's mouth and nose. It is thus freely inhaled. Its action can be maintained by giving liquor trinitrini [U.S.P. spiritus glycerylis nitratis] (3 m.) in a little water, six hourly during the first twenty-four hours. With the value of sodium tetranitrate in these circumstances the writer has never been impressed, and has now abandoned its use in favour of the above.

Depletion of the bowel favoured by older writers should if employed at all be used most cautiously. On more than one occasion one has seen the momentary elevation of the blood tension caused by straining at the evacuation induced by elaterium or jalap or calomel, which had been given in large doses, attended by a recurrence of hæmoptysis. If one wishes to deplete, it is open to one to do so by venesection, and so avoid this undoubted risk of incurring this real danger. The writer's experience is strongly against attempting to influence the course of an attack of hæmoptysis by depletory methods.

The action of the calcium salts in raising the coagulability of blood, claimed by Wright, has been seriously called in question by various observers. It is therefore with a certain amount of reserve that one recommends a line of treatment which rests upon Wright's work, even although, as is the case, one's clinical experience seems to favour these claims. It has been one's practice for years, and the practice has invariably been attended by success, to give calcium lactate (30 gr.) in a little water at the onset of hæmoptysis, and to repeat the dose in an hour, keeping up the treatment by giving the syrup of calcium chloride in one drachm doses in a little water every four hours up to forty-eight hours. The use of the calcium salts should not be continued beyond that time, as its continued use is believed at length to diminish rather than increase the coagulability of the blood, and so favour a recurrence of the hæmorrhage.

(3) *Severe Cases of Hæmoptysis.*—There remains this class of cases which are not at once fatal, but which threaten to be so owing to the great amount of blood lost either at the outbreak of the hæmorrhage or at a succession of less severe attacks supervening upon one another within a few days. By raising the foot of the bed and lowering the level of the chest an adequate supply of blood to the vital organs may be maintained until more blood is formed. To prevent syncope it may be necessary to administer strychnine or ether hypodermically. But brandy should be avoided. One's great stand-by in those cases has proved to be *gelatine* hypodermically injected. It may be procured from Martindale, in specially prepared tubes each containing 2 drachms. This is dissolved by placing the tube in hot water. Warm water is then added to bring the amount up to 4 drachms. The whole is injected hypodermically by means of a large metal syringe capable of holding the whole amount. The best site to inject is either immediately above or below Poupart's ligament—the former for choice. The writer's opinion of the value of this measure in grave cases is so high that he holds that the equipment required for applying the treatment on emergency is one which no sanatorium should be without. It has been objected that, owing to the fact that in the preparation of the gelatine, which it is understood is obtained from horses' hoofs, it is not brought to a sufficiently high temperature to kill any tetanus bacilli which may be present, tetanus may be communicated. This, however, is an accident which the writer has never seen occur, and probably the risk has been overestimated, and it certainly can be avoided by the proper preparation of the gelatine in the laboratories.

The diet for the first two days should be cold, and consist chiefly of milk. There is a danger incurred if the patient is kept on this low diet too long. The weakened state of the general resistance affords an opportunity for the disease to burst out into fresh activity. Therefore as soon as the bleeding has ceased, or within twenty-four hours of it having done so, the patient should be put on a solid diet; at first the lighter forms of nourishment such as scraped meat sandwiches, fish, sweatbreads and birds, and then within a day or two on to a full mixed diet including meat. Since this has become the writer's practice he has not met with nearly so many instances of post-hæmorrhagic infection, marked by sudden rise of temperature appearing about the third, fourth, or fifth week after the onset of hæmoptysis and the outbreak of fresh disease in some distant part of the lung, as he was accustomed to meet with when it was the practice to maintain a low diet for weeks on end.

Possibly owing to its richness in calcium salts, so favouring coagulation, and its high nutritive value, milk continues to hold its place as essentially the food to be given at a time of hæmoptysis.

Loss of Weight.—Patients usually gain weight on a full nourishing mixed diet, in which the carbohydrates, fats, and milk are rather over than under represented. For details, readers are referred to the special article dealing with the Principles of Dietetics. It may be useful, however, to refer to two practical points. During the febrile stage of the disease, provided the patient's digestion is sound, the food ought to be pushed almost to stuffing point. If the very large amounts cannot be borne, by adding plasmon (ʒj to ℥ij daily), casumen (℥ss. daily) or somatose (ʒj three times daily), and one of the cod-liver oil or cod-liver oil and malt preparations to a reduced diet, weight may still be gained. No advantage is secured, but rather the contrary, by stuffing in food until vomiting is induced. When patients approach their top weight, which usually is from half a stone to a stone above their highest known weight, the rate of gaining falls to very small amounts. The digestion is apt to begin to cause trouble. This is an indication to reduce substantially the amount of food taken. The milk may be reduced to half the usual amount. When this reduction has been made, not only is the threatened digestive breakdown warded off, but the patient resumes gaining weight again and feels much better than when on the full diet.

Alcohol is for the most part contra-indicated. Exceptions should be made in the cases of persons over fifty years of age, whose habit in life has been to take a night cap of whisky or toddy before retiring. So long as it is restricted to this there is no reason for interfering with the habit. Withdrawal of alcohol in such cases may be followed by onset of insomnia, therefore it is prudent to leave well alone.

COMPLICATIONS.

The complications of pulmonary tuberculosis with which the sanatorium physician is called upon to deal are legion. Amongst the more common are the following:

(1) **Pregnancy.**—In so far as the pregnant state does not seem materially to modify pulmonary tuberculosis in multipara it calls for no further mention. Very different, however, is it in the case

of primipara. Out of a large number of primiparous consumptives met with during the past ten years in which the pregnancy has been allowed to go to full term, the writer has seen only one in which the patient has survived the confinement for a period of two years. There is one clear indication in those cases. The uterus should be emptied as early as possible. Where this is done an otherwise unfavourable prognosis becomes as favourable as that of an ordinary uncomplicated case.

(2) **Syphilis.**—This is not necessarily a serious complication. Where the patient has been treated for syphilis on the ordinary lines, under sanatorium conditions of life, complete and satisfactory recovery frequently takes place. In this connection the writer recalls with somewhat mixed feelings the instance of a man suffering from acute caseous disease, who was under his care for a period of six weeks. At the end of that time the friends were informed that the outlook was unfavourable, and were advised that the patient be removed home without delay. On the evening preceding his removal, the patient confessed that he had contracted syphilis twelve months before, and that it had not been treated. This information was forwarded to the patient's family doctor, who placed him in a tent and at once exhibited mercury and iodides. The patient made a complete recovery, and remains well.

(3) **Ischio-rectal Abscess.**—When the presence of an ischiorectal abscess is suspected a thorough examination should at once be made. Slight local swelling, combined with induration and pain on pressure, more especially where the local pain is of a stabbing, cutting character, and can be induced by coughing, warrants operation. Under no condition should the abscess be allowed to burst of itself. The patient should be thoroughly anæsthetised, and an attempt made to excise the abscess sac and secure healing by first intention. If this attempt fails or no sac is present, a free incision should be made, all doubtful tissue removed and the base of the wound scraped or curetted. The wound should be packed and afterwards treated on ordinary surgical lines. This usually results in the avoidance of fistula, and the ultimate formation of a sound scar. Peroxide of hydrogen seems to be the best application. The wound closes within a time which varies from three weeks to six months, but is usually about twelve weeks.

(4) **Tuberculous Cystitis.**—This constitutes a serious complication. Urotropine (10 gr.), combined with 5 min. of the tincture of hyoscyamus, exerts a beneficial effect upon the condition and relieves in a measure the distressing frequency of call. But the one

efficient remedy of proved value in those cases is tuberculin T. R. Its administration, however, is not unattended by risks. This is particularly the case where the ureters are involved. The writer has had experience of one case in which uræmia followed the administration of tuberculin and proved rapidly fatal. No doubt in this instance death was brought about by local reaction to tuberculin taking place in the ureters, which caused complete blocking of the channels, and subsequent suppression of urine. Before proceeding to administer tuberculin in such a case it is prudent to obtain by cystoscopic and rectal examination some idea as to the exact condition of the bladder, the ureters, vesiculae seminales, etc. The greater the involvement the smaller must the initial dose of tuberculin be (*see* Tuberculin Therapy, Vol. III.).

(5) **Tuberculous Epididymitis.**—The bearing of this complication is purely a local one. It does not seem to determine the course of the lung disease either towards a favourable or an unfavourable issue. Sometimes the local disease subsides under tuberculin treatment, but in the writer's experience where this has occurred it usually recurs at a later date. The removal of the whole testicle at an early stage is the best means to prevent the spread of infection to the other testicle. Only too frequently the temporary arrest of disease in an affected epididymis in the long run is followed by the loss of both testicles.

(6) **Albuminuria.**—Where the albuminuria and pulmonary tuberculosis have together supervened upon a short period of excessive use of alcohol, and the patient has come under treatment early, the albuminuria usually completely clears up under treatment by rest and milk diet. When the lung condition supervenes upon an established albuminuria the outlook is invariably unfavourable. Its significance is then most grave. In the writer's experience the outlook is hopeless, and death is rarely delayed beyond a few months. No known treatment is of any avail. There is still a further type corresponding to the albuminuria of adolescence. It occurs in male patients mostly between thirty-five and forty-five years of age. It is not modified by dietetic treatment, and seems to have no bearing, favourable or unfavourable, upon the course of the lung disease. Such cases frequently recover from the pulmonary condition and continue to exhibit traces of albumin in the urine from time to time. In regard to the prognostic significance of albuminuria it may be mentioned that in the writer's experience no treatment has been found to prolong life for a longer period than two or three months when albuminuria is found associated with Ehrlich's diazro-reaction of the urine.

(7) **Diabetes.**—This is a hopeless complication, and death is rarely delayed beyond nine months after the onset of the glycosuria. It is most frequently fatal between the third and fourth month.

(8) **Pleurisy.**—This complication is not always an unmixed evil. Occurring at the apex it may form an apical cap, and by limiting movement in the lung favour arrest. Occurring lower down not only the pain but the tendency to fluid formation can be largely controlled by "strapping." That this measure seems to have a bearing in controlling fluid formation the writer infers from the circumstance that since he adopted it as a routine practice in the treatment of cases of basal pleurisy over six years ago he has not found it necessary to perform paracentesis on a single occasion. Previous to that the necessity for tapping was not uncommon. Antikamnia (5 gr.) or phenacetin (4 gr.), with citrate of caffeine (3 gr.), or tinct. opii (in 10 min. doses) [U.S.P. 6 min.] or heroin hydrochlor. ($\frac{1}{12}$ gr. six hourly), are suitable anodynes, should the pain prove troublesome. If fluid appears and requires to be tapped, the chance of recurrence seems to be lessened by withdrawing slowly instead of quickly. A fine needle should be used, and the operation ought to occupy not less than forty minutes. Done in this way it is rare indeed that the operation requires to be repeated.

(9) **Empyema.**—The treatment of this complication is entirely surgical.

DAVID LAWSON.

THE TREATMENT OF PULMONARY TUBERCULOSIS BY GRADUATED LABOUR.

Before commencing to treat a patient with exercise the following conditions must be fulfilled: (1) The patient must be absolutely free from fever and all constitutional symptoms. (2) The patient must be able to be up all day fully dressed, and able to walk about the house in the ordinary way.

These conditions being fulfilled, the next thing is to endeavour to restore the patient's physical capacity, and by means of auto-inoculation to raise his specific immunity to his disease by driving larger and increasing doses of his bacterial products into his blood, until he is able to take severe exercise without risk of suffering from fever and constitutional symptoms. Thus by increasing his protective substances his specific immunity is to be gradually raised to deal with each fresh dose of toxin.

These objects are accomplished by systematic labour, by means of which the mobility of the lungs can be controlled. The system in force at the Brompton Hospital Sanatorium includes six grades of labour, preceded by a preliminary treatment of walking, which varies in time and extent according to the individual. Walking is first prescribed for all patients, and each case is considered on its merits. Those patients who have been kept in bed owing to fever start by walking ¼ mile a day. The remainder of the day is spent resting. It is very necessary to see that the rest is effectually carried out, because if it is not there is no accurate control over the doses of toxins. This treatment is continued for a week, and if at the end of that time the patient is feeling well and there are no constitutional symptons, the distance is increased to ½ mile. The conditions still being satisfactory, the following week the distance is increased to 2 miles; the next week increased to 4. The patients on this and all higher forms of exercise clean their wards and do other domestic work connected with their own part of the building.

The final walking grade is 6 miles. Should, however, the patient's condition not be satisfactory on any one of these grades of walking, the patient remains on that grade till all unfavourable symptoms have passed off. These symptoms are, first, loss of appetite; second, rise of temperature to 99°, accompanied by headache; and third, increase of sputum, accompanied by deviation in the temperature chart. If there is a rise of temperature, the patient must be treated on the lines of *complete* rest. This will be detailed later. Patients who have been kept in bed owing to fever must be judged by what they have done previous to their admission: thus, if a man has remained at work until he commenced this treatment, it is obviously unnecessary to put him through the grades of walking; it may be assumed, as he has remained at work, that he is immune to any dose of toxins that 6 miles a day can place in his blood. As a general rule most patients who have not been confined to bed start on 4 miles a day.

It is necessary here to point out the significance of physical signs. If a patient has very marked physical signs with cavities, for example, involving four lobes, but is, nevertheless, in good muscular condition, it is obvious that his resistance must be high, whereas if a patient has no signs at all, but tubercle bacilli in his sputum and very poor physique, it is practically certain that his resistance is extraordinarily low. Now the former patient is probably fit to be started on 6 miles without danger, whereas the other patient, who would be generally styled an early case, is probably unfit for any active exercise.

The reason why patients are kept on these walking grades for a week is that it takes this time to get their muscles so accustomed to the exercise as not to tire them. It is quite possible that one day on 4 miles would be enough to raise the patient's immunity to that amount of exercise, but in practice it is found necessary to keep them on the grade for a whole week. The period fixed is not arbitrary, and it is wise to err on the safe side.

Patients who have completed the 6 miles pass on to the first grade of labour; this consists in carrying baskets containing various materials a distance of about 50 yards, the weight carried averaging 10 lb., and the distance travelled about 7 miles. This grade is very important, as it provides definite work for the patient, restores his physical capacity, and tests his power of resistance to toxins. If a patient is very susceptible to toxins he is always kept on the basket-work itself and is not allowed to do work of corresponding degrees of severity, because the basket grade is a very definite measured task, whereas weeding, potting, and similar light work allow the personal factor to come in and afford an opportunity for excessive zeal. In private practice it may be found impossible to use this basket stage, and the equivalent of it is about 10 miles walking in four and a-half hours. In walking alone, however, the muscles of the arms are not being trained in any way.

If the patients pass the first grade successfully they then proceed to the second grade, which is carrying a larger basket containing about 18 lb. of material for the same time and distance. This grade having been passed successfully, the next grade consists of such work as sweeping paths, chopping firewood, cutting grass, hedging, hoeing, etc.; in short, what is termed light work about a house or garden. As a rule patients remain on these three grades about a week. The next grade, No. 4, is equivalent to the use of a small shovel. Patients on this work will dig 2 tons of earth and lift it 7 feet into a cart, and towards the end of the grade they will lift into it about twice that amount. The last grade is heavy navvy work, and men on this will lift 6 to 8 tons of material a day 7 feet, or will mix 10 tons of concrete in the same time.

Patients generally remain on grade 2 for one to two weeks, grade 3 one to two weeks, and grade 4 two weeks, and on grade 5 for three weeks.

Three weeks from the date of their discharge patients work an extra three-quarters of an hour during the rest hour, in addition to the indoor work which is incumbent on all the patients.

The work for the women is the same as for the men, but the various implements are lighter, and they do not work so hard.

It is, of course, very much easier to treat patients in a sanatorium on these lines than in their own homes, because in the sanatorium they have the medical officers to encourage them in keeping at work, and they have also the moral support of their fellow-patients. In their own homes, especially at the beginning of the treatment, when they are feeling listless and ill, it needs a great amount of courage on the part of the patient to perform monotonous routine work. If, however, treatment has to be carried out at home, the walking can be continued by gradually increasing mileage until a standard of about 14 miles a day in four and a-half to five hours is reached. This will correspond to all the first three grades of work. In order to get the muscles of the arms into good condition dumb-bell exercise must be employed, and here it will be best to test each patient by himself, giving him dumb-bells of adequate weight and allowing him to use them for five minutes a day, gradually increasing the time to about half an hour; or if it is so desired, dumb-bell exercise may be increased and the walking curtailed. Another means of getting exercise for the arms is by driving, and a patient might walk his allotted number of miles and then drive for, say, an hour a day; it must, however, be remembered that, in departing from the basket grade, there is always the danger that the dose is not being accurately measured. Therefore any increase in exercise should be very gradual, so as to run no risks.

Grade 4 might be replaced by one round of golf of eighteen holes, and it would be well in starting a patient on this game to let him play over an easy nine-hole course first. Grade 5 would correspond to from two to three rounds of golf a day. Here, again, the patient had better start on two rounds and remain on the two rounds for a fortnight, increasing to three at the end of that time. Tennis and other games where competition enters are better avoided; as with all the good intentions in the world patients can over-exert themselves without thinking what they are doing. In fact, it is always easier to overdo it in sport than in work.

These remarks do not exhaust the possibilities of home treatment. They are intended rather to suggest how and by what various means we may treat those patients who are unable to enjoy the benefits of a sanatorium, by turning to account the different exercises and amusements to which they are accustomed.

The whole system must depend not merely on careful grading of labour, but upon the intelligent application of work to individuals. Exceptions are so numerous that it is dangerous to put faith in general rules.

GUIDES TO THE CONTROL OF THE AUTO-INOCULATION.

The first symptom that a patient is receiving excessive doses of toxin is that he begins to lose his appetite. Should this condition occur it is well to put him back a grade until the appetite is restored. Usually when a patient reaches the amount of exercise to cause auto-inoculations there is a marked increase in the sputum, accompanied by deviation in temperature, and this need cause no apprehension, since it will be found to disappear gradually as the patient becomes immunised to the toxins. Should, however, the sputum continue to increase it is almost certain that the patient is doing too much work, and he should again be brought back to a lower grade or rested a few days until the sputum diminishes. If a larger dose of bacterial products is poured into the blood than can be conveniently dealt with by the blood, this over-dose will cause a rise of temperature and constitutional symptoms. This must be treated by **absolute rest**. The patient must be put to bed and treated like a patient suffering from typhoid fever, that is, not allowed to read, to talk, to have visitors or to move in any way; he must be closely nursed and not allowed to cut up his food himself, or indulge in any activities which might unduly influence his toxins. If these precautions are taken it will be found that the temperature will return to normal, as a rule, within three days. In order then to ascertain if the patient is still suffering from constitutional symptoms he is tested as follows: As soon as the temperature has been normal for twenty-four hours he is allowed to sit up and read in bed;

next, the temperature still remaining normal for twenty-four hours, he is allowed to wash himself. The temperature still remaining normal for twenty-four hours, he is allowed to get up for half an hour. The next day he is allowed up all day, and if he has been on any grade of work, he is allowed to walk 6 miles to see that the balance of his protective substances has been restored. If he can walk 6 miles without any rise of temperature he is then put back to the grade on which the rise of temperature occurred. In practice it is found that this rise of temperature does not recur, because the patient, through the agency of the large dose for which he has been already treated, has immunised himself to such a dose.

Special attention must be paid to a mouth temperature of 99°, accompanied by headache and other symptoms of illness. If patients who develop this temperature and symptoms are invariably treated on the lines of absolute rest, no evil results will follow, but if it is neglected it is impossible to foretell the consequences. A temperature of 99° and over can occur without constitutional symptoms, and then it can be disregarded. This is especially so in patients with extensive signs of disease.

A temperature of 99·6 in women corresponds to the temperature of 99° in men.

The accompanying table may be of some interest, showing how a patient who started in bed with fever gradually increased her resistance to bacterial products by means of carefully graduated exercise until finally she was enabled to ride hard for 2¾ hours without any ill effects.

TABLE SHOWING INCREASE OF EXERCISE OF PATIENT TREATED AT HOME, FROM THE TIME THE PATIENT WAS ABLE TO BE UP ALL DAY:

Day of increase of exercise.		
1st day.	Walked 20 minutes.	
2nd ,,	Walking ½ hour at 2 --2½ miles per hour.	
6th ,,	,, 1 hour.	
15th ,,	,, 1½ hours.	
20th ,,	,, ,,	Driving 1 hour.
23rd ,,	,, ¾ hour.	Riding ½ hour.
24th ,,	,, ¾ hour.	Riding 1 hour.
38th ,,	Riding 1½ hours.	Driving 2½ hours.
46th ,,	,, 1¾ hours.	,, ,,
53rd ,,	,, 2 hours.	
63rd ,,	,, 3 hours.	
66th ,,	,, 3¾ hours.	
68th ,,	Hunting, 2½ hours.	
73rd ,,	Riding (hard) 2½ hours.	
80th ,,	,, ,, 2¾ hours.	

This patient, as a rule, rested on Sundays.

MARCUS PATERSON.

THE TREATMENT OF PULMONARY TUBERCULOSIS BY THE INDUCTION OF AN ARTIFICIAL PNEUMOTHORAX.

The treatment of pulmonary tuberculosis by injecting gas into the pleural cavity, and thereby forming an artificial pneumothorax, was first instituted by Professor Forlanini in 1892. In 1895 J. B. Murphy published his original observations on the subject, and since then the treatment has steadily gained favour, till it has now been adopted by most of the leading sanatoria and hospitals for diseases of the lungs on the Continent and in the United States. Although the indications for the treatment are such that only a small minority of cases are suitable subjects, and though the undertaking presents difficulties and dangers which require considerable care and skill on the part of the operator, yet several hundreds of patients have already undergone the treatment.

In the absence of active tuberculosis elsewhere in the body, it has been shown that, in the majority of cases when complete collapse of the diseased lung is effected, the temperature rapidly falls to the normal, bacilli disappear from the sputum (if any remains), the general condition improves, and the tuberculous foci become encapsuled by firm, fibrous tissue. When the treatment is completed and the lung is allowed to re-expand, it presents the signs characteristic of a lung in which the disease has been arrested.

Seat of Election.—The choice of the point at which nitrogen, which is found to be rather more slowly absorbed than air, should be injected depends on the condition of the lung. The neighbourhood of cavities should be avoided, and a site should be chosen where the lung appears to be healthiest. Not only is the chance of finding non-adherent pleural surfaces at this point greatest, but the risk of infecting the pleura from a wound in the lung is also least.

The site most commonly chosen is in one of the axillary lines: in the seventh, eighth or ninth intercostal space. It may, however, be necessary to choose other points at the back or front of the thorax, and when the first, second or third intercostal space is selected, care must be exercised so as to avoid wounding a blood-vessel or cavity, which in this locality is usually near the surface.

To lessen pain and to inhibit pleural reflex, ¼ gr. of morphia is administered subcutaneously half an hour before the operation; it is also advisable to employ a local anæsthetic, such as stovaine or eucaine.

TECHNIQUE.

The apparatus consists of two glass cylinders or bottles, one of which is graduated. The graduated bottle has attached to it indiarubber tubing, which communicates by a T-shaped glass tube with a glass manometer containing water, and with a hollow needle. The graduated bottle is filled with nitrogen, and the other with an antiseptic solution, which by syphonage, or by the use of hand-bellows, is made to displace the nitrogen. The gas is thus gently driven through the tubing and needle into the patient's pleural cavity. A couple of sterilised cotton-wool plugs are placed in the course of the tubing to filter the nitrogen, and two clamps are attached to the tubing, so as to cut off when necessary the bottles or the manometer from the needle. The manometer in the illustration is graduated in centimètres (Fig. 1). In reading it, note should be made that the pressure recorded when the water in one limb is depressed 5 centimètres is 10 centimètres, *i.e.*, the difference in level between the water in the two limbs.

Saugman's needle (Fig. 2) is fitted with a side stem, to which the tubing is attached. It is also fitted with a tap which, when open, allows of the passage of a stilette. When ready for use, the stilette is withdrawn and the tap is shut.

The nitrogen having been allowed time to warm, the patient is placed in the recumbent position, and the skin sterilised. It is often advisable to place a pillow under the patient's chest, and to raise his uppermost arm so as to widen the intercostal spaces, and thus facilitate the introduction of the needle. To avoid complete failure at the outset it is essential that the tubing, the filters, and the needle should be thoroughly dried before use; otherwise the manometer will not record the changes of pressure at the needle's point, and the operator will be deprived of his main guide to its position. If a dry steriliser is not available, the needle should be dried over a flame and by shaking after it has been boiled. Or drying may be facilitated by keeping the needle in absolute alcohol. Any water in the indiarubber tubing should be removed by carefully squeezing it out, and then whirling the tube in the air. The water in the two limbs of the manometer is brought to the same level at the figure 0 immediately before operating by opening each limb freely to atmospheric pressure. It must be similarly insured that the pressure in the nitrogen bottle is also atmospheric.

Before the needle is introduced, the tube leading to the bottle of nitrogen is clamped, while that which connects the manometer with the needle is left open. The operator then makes sure of the oscillations of the water in the manometer by stopping and then compressing the tubing which connects it with the needle. The needle is now steadily, firmly, and vertically thrust through the

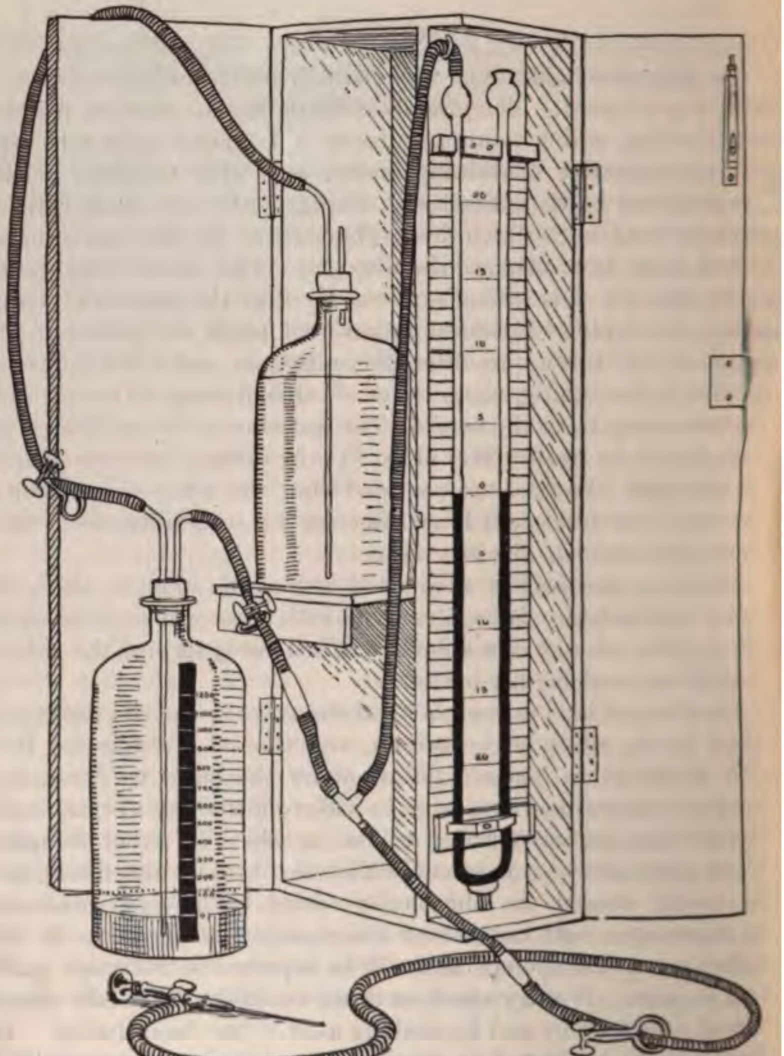


FIG. 1.—The writers' nitrogen apparatus.

skin and between the ribs to the depth at which the pleura is to be found. Some operators thrust the needle obliquely into the chest, so that, when the needle has pierced the parietal pleura, it may glide over the visceral pleura without wounding it. The disadvantage of this procedure, however, is that it increases the difficulty of gauging the depth at which the operator is working. By keeping a light hand on the needle, the operator is frequently able to detect the slight resistance which the parietal pleura offers to the needle's point as it meets and passes through this structure. As soon as the needle's point has reached the space between the two layers of the pleura, the water in the manometer rises in that limb of the manometer which is nearest the needle, showing a negative pressure of several centimètres of water. The column of water now oscillates with the respiratory movements, a typical reading being — 8 centimètres on expiration and — 12 centimètres on inspiration. The clamp cutting off the nitrogen is now released, and 10 to 20 cubic centimètres of gas pass into the pleural cavity. The nitrogen is again cut off, and the manometric oscillations are recorded. Small quantities of nitrogen are now admitted under repeated control of the manometer till 300 to 400 cubic centimètres have been injected. It is wiser not to give more than this at the first injection, to avoid much pain and discomfort during the subsequent twenty-four hours. If pleural adhesions are absent, this quantity of gas will only have raised the intra-pleural pressure by 1 or 2 centimètres at most; but if the pleural surfaces are only partially free, and adhesions are present, the pressure will rise rapidly. After the needle has been withdrawn the patient is kept quiet and in the recumbent position. No antiseptic dressings are required, and the use of collodion is to be deprecated, as it interferes with subsequent injections which are usually given at the same site.

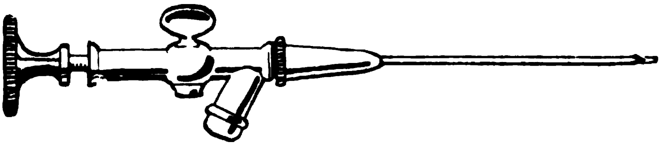


FIG. 2.—Saugman needle.

Difficulties in the Course of the Operation.—It frequently happens that the needle becomes choked with blood or connective tissue. When this occurs, no oscillations appear, even when the point of the needle is between the two layers of the pleura. The needle may, therefore, have to be frequently cleared by the stilette. The needle is sometimes thrust through the visceral pleura into the lung by the operator, who fancies he has not yet reached the pleura. Then oscillations about 0 occur. When the needle is found to be occluded by blood, unless it can be cleared with the stilette it should be withdrawn, and another needle should be substituted, or the original one should be washed out with ether. It is advisable under such circumstances when re-introducing the needle to avoid the original wound, as there will probably be suffused blood at this point. In certain cases the difficulty of obtaining typical oscillations is so great that after repeated efforts to obtain them the operator is justified in admitting a small quantity of gas, in the hope that it will escape into the pleural cavity and separate its two layers. But to avoid the risk of gas embolism, which may produce instantaneous death, this step must never be taken before the operator has convinced himself that the point of the needle is not in a vein. This is done by opening the tap and aspirating with a syringe, the nozzle of which fits tightly into the base of the needle. If blood is withdrawn, the needle should at once be removed; but if none appears, the tap is again shut, and about 10 cubic centimètres of gas are admitted through the needle. By the addition of a little scent to the nitrogen the patient is able to detect its presence in his breath, if the nitrogen has escaped into the lung. If the nitrogen has escaped into the tissues external to the pleura, it causes surgical emphysema. This condition is of little importance when the emphysema is subcutaneous; but when it is deep, it may cause considerable discomfort; and dysphagia, due to gas which has tracked up the cervical fascia, is a troublesome complication.

The patient may show signs of pleural reflex, in which case the needle should at once be withdrawn. The operator must closely watch the patient's colour, and any complaint from the latter of faintness, or of "feeling queer," is a clear indication for the removal of the needle. Neglect of this precaution may be followed by total loss of consciousness on the part of the patient, who presents the typical signs of pleural reflex, and may be dead in a few minutes. Several deaths have been reported from this cause in the induction of artificial pneumothorax. Fortunately, this condition is relatively rare, and Saugman, with an experience of over 100 patients and over 2,100 injections, has reported only one fatal case.

The Completion and the Maintenance of the Pneumothorax.—In the absence of adhesions, the small quantity of gas which has been injected on the first occasion spreads over the whole lung. It, therefore, barely separates the one layer of the pleura from the other, and a second injection of about 500 cubic centimètres of gas is consequently given next day. The physical signs indicating the completeness or otherwise of the pneumothorax must be regularly watched. The injections should be continued daily until the lung is completely collapsed, and a positive intra-pleural pressure has been obtained both on inspiration and on expiration. When this state has been reached, and that is usually within about a week, intervals of two or three days to a week may be allowed between the injections. Later, these intervals may be increased to several weeks, when the patient's capacity for retaining nitrogen has been learnt. During the first few months of the treatment the pressure should be kept consistently positive, as this is essential for the complete immobilisation of the lung. In uncomplicated cases the maintenance of the pneumothorax may be easily carried out in the patient's home by his medical attendant.

Duration of Treatment.—The treatment must be continued until complete cicatrisation of the tuberculous foci has occurred. No hard-and-fast rule can be laid down. Probably, in most cases, the treatment should be continued for one to two years at least. When the disease has been chronic, and has destroyed most of the lung, little can be gained by restoring the remaining small quantity of healthy pulmonary tissue to functional activity; whereas there is an appreciable risk in such a case of a recrudescence of the disease if the lung is allowed to re-expand. Considering the ease with which a pneumothorax can be maintained, it is no hardship for such a patient to continue the treatment for a long time.

When severe but recent disease has necessitated the compression of the lung there are circumstances which can permit the re-expansion to be allowed after so short a period as one year. There are a few cases reported in which success has been reached by compression for only six or seven months. But probably the risks entailed by such a short compression are not worth taking. Judgment as to duration depends chiefly upon these two factors: (i.) a knowledge of the state of the disease before compression; and (ii.) the symptoms of the patient before re-fills, and a certain amount of experiment in cautiously prolonging the intervals between re-fills, short of allowing complete absorption of the gas.

Occasionally adhesions or thick-walled cavities permit of only the compression of half the lung or less. This is frequently sufficient to arrest the disease, but the process of cicatrisation is naturally delayed by the partial activity of the lung, and the treatment must consequently be prolonged.

COMPLICATIONS.

Pleurisy with effusion occurs in about one-half of the cases treated. It is usually associated with a rise of temperature lasting for a few weeks, and as a rule falling by lysis. Although it is a valuable aid to the compression of the lung, it occasionally turns the scales in favour of the disease, which henceforth runs a rapid and fatal course. Fortunately, this complication does not often appear until the treatment has lasted for several months, when the patient's power of resistance has been considerably raised. If the effusion is considerable, it may cause such severe dyspnœa that aspiration of a large quantity of the fluid or gas is necessary. It is sometimes possible to cut short the fever by substituting nitrogen for the fluid. After the re-absorption of the fluid the pleura becomes less permeable, and the nitrogen may, therefore, be injected at longer intervals than before.

Dyspepsia is frequently caused by the mechanical action of the pneumothorax, but it is seldom very troublesome. Tachycardia, dyspnœa, pain in the chest and general discomfort all rapidly disappear as the thoracic organs adapt themselves to the change, and when the temperature has fallen to normal the respiration and pulse-rate generally also fall.

MODIFICATIONS OF METHOD.

Murphy's method, adopted by Brauer, is known as the open method. Under local anæsthesia an incision, 5 to 7 centimètres long, is made through the skin over an intercostal space. The underlying structures are divided or displaced so as to expose the parietal pleura, which is carefully punctured by a blunt cannula. A large quantity of gas is now admitted under the control of the manometer. The cannula is withdrawn and the wound is sutured. In subsequent injections Forlanini's method is adopted. The advantages of the open method are these: (1) the danger of gas embolism is lessened; (2) the visceral layer of the pleura as well as the lung cannot so easily be injured, and therefore there is less risk of infecting the pleural cavity from within. The disadvantages are these: (1) the operation of incision is a more formidable undertaking than a puncture; and it is often impossible to find free pleural surfaces until several explorations have been made; (2) there is more risk of accidental infection from without by micro-organisms of the septic group; for example, a fatal case of empyema originating in a septic ligature has been reported: (3) a fistula sometimes forms at the site of the incision.

Forlanini's method is preferable, for it enables the physician to produce the pneumothorax with almost negligeable risk of the two above mentioned disadvantages of the open method so long as the precautions already described are conscientiously observed. In this connection mention may be made of the fact that several needles have been invented which aim at meeting all requirements. Some of these (*e.g.*, Courmont's) are ingenious, but most frequently the less elaborate instrument, like Forlanini's, is in practice the best. The writers have had modifications of Begtrup Hanson's and of Courmont's made (Fig. 3), which they consider applicable for first injections upon the occasions when Saugman's or Forlanini's needles have failed.

THE CHOICE OF PATIENT.

The treatment is heroic and but comparatively rarely applicable. It must not be lightly undertaken, and it must be confined to those patients for whom ordinary treatment has failed, or is likely to fail. Early cases, therefore, are not eligible. It is to be used for patients whose disease is severe. Occasionally, in a moderately severe case responding but slowly to sanatorium *régime*, it may be necessary to consider whether artificial pneumothorax would save time, even though a considerable amount of healthy lung would have to be put out of action; for the more healthy the lung tissue is, the greater is the chance of the collapse arresting the disease in a short period. So long as progress towards recovery is being made, it is better to adopt the less radical form of treatment. There is not enough evidence to show that the procedure would save time under such circumstances, nor enough experience in such cases of ultimate results by this method to warrant adopting the more drastic measure.

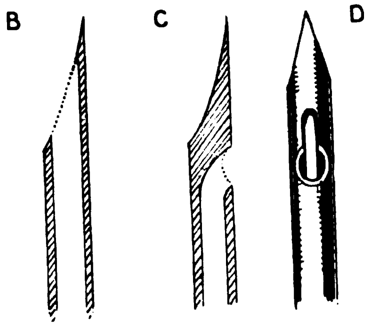


FIG. 3.—B Saugman's needle; C, D the writers' modification of Begtrup Hanson's needle.

The treatment must be confined to those whose disease is chiefly one-sided. There must be one lung either with no lesions in it or with very few. This is the most important factor of all. Correct appreciation and a skilful interpretation of the exact physical signs are essential; and for this X-ray examination may be helpful. The knowledge of the patient's condition must be as complete as possible, especially in respect to the severity of the disease in the respective lungs. This requires that the judgment should not be made hastily, and that it should be founded upon some special knowledge of consumption, and a nice weighing of all the features of the malady in the particular individual. Almost all cases with severe disease on one side have a little on the other, even though no abnormal signs can be detected there. Nearly always if artificial pneumothorax is applicable, the sounder side must be in good working order, and must show no abnormal physical signs, or only those of slight and quiescent, or thoroughly healed, disease. Otherwise, the production of an artificial pneumothorax is unlikely to lengthen life or alleviate symptoms. But, perhaps, it should be mentioned that Forlanini has reported several cases of bi-lateral disease treated by alternate compression of the lungs. One lung is compressed for a year or two, and is then allowed to re-expand when the other lung is in its turn compressed.

The treatment cannot be successful if adhesions and thickening preclude the possibility of producing an effective pneumothorax. It is impossible beforehand to be sure of the presence of these hindrances to success. Again, the differential diagnosis between a localised natural pneumothorax and a large cavity is usually far from easy. Hence, it is often expedient to make several efforts to produce an artificial pneumothorax before deciding that nothing can be done by this method. Furthermore, if the adhesions and thickening are thought to be in one part of the chest, and the severe disease in another, a partial pneumothorax can sometimes produce great benefit.

Naturally, the doctor advising the treatment should be sure that he is not merely subjecting a dying patient to additional trouble and pain. But some cases apparently hopeless under ordinary treatment have been saved by this method. Artificial pneumothorax must be undertaken occasionally with a view to stopping severe hæmoptysis. Profoundly acute disease, severe laryngeal, intestinal or other complications have been judged contra-indications by some authorities. But, though due weight must be given to such features, they need not of necessity and by themselves negative the decision. The treatment can be given up at any time; but, if it is, then it is not as a rule applicable again to the same side, for the two pleural surfaces usually become adherent. The amount of medical supervision may be less when an artificial pneumothorax has been produced than it would be to maintain improved health without this method.

The patient must show a moderate degree of sense in appreciating, and pluck in observing, the ordinary restrictions and care which are necessary for maintaining health. The treatment is probably less applicable to patients of the artisan class for sociological rather than for medical reasons. Though the restrictions placed upon an individual with an artificially produced pneumothorax are surprisingly slight provided the useful lung is in full, or almost full, working capacity, yet such an individual is capable neither of heavy physical work nor of the long hours usually associated with even light work in the case of the artisan classes.

S. VERE PEARSON & CLAUDE LILLINGSTON.

NEW GROWTHS OF THE LUNG.

In all cases the possibility of Syphilis should be remembered. If Syphilis cannot be excluded a course of full doses of iodide of potassium should be given. When the tumour is of a malignant nature we have to expect a fatal result in from a few months to a year or more. Treatment is therefore entirely symptomatic. Pain may sometimes be relieved by strapping. In some instances the dyspnœa and general distress are relieved by a mixture of sodium iodide (gr. 3 to 5), chloral hydrate (gr. 5 to 10), aq. caryophyll. (ad ʒj), four to six times in twenty-four hours. Heroin, especially when injected, may be of service. At first the dose may be $\frac{1}{12}$ gr., but usually much larger doses are soon required. In most instances we have to rely on morphia. This drug must be pushed if necessary, and the doses regulated so that they give definite relief. Oxygen, through warm water, may lessen the dyspnœa in some cases. When a *pleural effusion* occurs, it should not be tapped unless it adds definitely to the distress of the patient. When the fluid is present in such quantity that it increases the dyspnœa, a portion of it (20 oz. or more) may be withdrawn. It is unwise to attempt to remove the whole quantity of fluid present, for not only does this condition recur, owing to the chronic irritation of the pleura, but such an attempt may lead to heart failure. Patients suffering from intra-thoracic growth usually die from heart failure, and it is well to remember that this may take place during or shortly after paracentesis, whether a small or large quantity of fluid is withdrawn, but more frequently under the latter circumstances. This fact should, however, not deter us from drawing off a portion of the fluid, if its presence is increasing the patient's discomfort (*see also* New Growth in the Mediastinum).

ARTHUR LATHAM.

SURGICAL TREATMENT OF GROWTHS OF THE LUNG.

Tumours.—Although portions and whole lobes of the lung have been removed for tuberculous disease, the results have not been favourable, and the cases in which a similar proceeding could be undertaken for a tumour must be extremely rare.

Actinomycosis.—This affection is probably produced by inhaling the fungus. It may be diagnosed early by finding the fungus in the sputum, but as the symptoms are quite indefinite at first the disease may have made considerable progress before it is recognised. Often it is not diagnosed until the pleura and chest wall have become affected.

Sometimes it begins apparently in the thoracic wall or pleura.

Incision and repeated scraping away the disease as completely as possible with the administration of iodide of potassium have secured the best results. The prognosis is not good if the chest wall and pleura have become extensively involved.

Hydatid Cyst.—This is not a common affection in this country, but the reports of surgical treatment from other countries, *e.g.*, Australia, give a favourable prognosis.

The surgeon should avoid treating these cysts by puncture, for although favourable results have been obtained by such treatment it is a proceeding accompanied by certain risks. Fatalities have occurred due to the hydatid fluid making its way into the bronchi and causing asphyxia. When the diagnosis has been made and the position of the cyst determined, resect two or three ribs in the required position and ascertain whether the parietal and visceral pleural are adherent. If so, incise the cyst, evacuate its contents and drain the cavity. If there are no adhesions proceed as for lung abscess. It is best not to wash out the cyst.

H. S. PENDLEBURY.

AFFECTIONS OF THE MEDIASTINUM.

INFLAMMATORY CONDITIONS OF THE MEDIASTINUM.

Acute inflammation, with formation of abscess, from injury or septic infection, falls within the province of surgery as regards any treatment beyond mere relief of symptoms and perhaps the use of an appropriate vaccine or serum.

The same is true as regards any chronic inflammation, such as that set up by tuberculous disease of sternum, vertebræ or glands, if caseation and softening result.

Concerning chronic indurative mediastinitis with pericarditis, *see* article on Chronic Mediastino-Pericarditis, p. 1186.

CYRIL OGLE.

SURGICAL TREATMENT.

This depends a great deal in the acute cases upon the diagnosis of pus in the anterior mediastinum. If an accurate diagnosis from the history and symptoms aided by X-rays is possible, an attempt should be made to evacuate the pus by trephining the sternum and cutting away with Hoffman's forceps as much bone as is necessary to discover the abscess. The prognosis is very grave and the patient may die of acute septicæmia or infection of the pleura or pericardium. The more chronic cases and those of a tuberculous nature are treated in the same way, but their prognosis is much more favourable.

H. S. PENDLEBURY.

CASEATING TUBERCULOUS GLANDS IN THE MEDIASTINA.

In the anterior mediastinum the treatment is that of pus in the anterior mediastinum.

In the posterior or superior mediastina this condition is not usually amenable to surgical treatment, but the writer has met with two or three cases where a mediastinal tumour was diagnosed, and a mass could be seen under X-rays in the posterior mediastinum in one case and round the great vessels in another. Both were in tuberculous children about twelve years of age. After explaining the dangerous nature of the operation to the friends, it was agreed to as a last chance. Two portions of rib, about 3 to 4 inches long, were resected in the mid-axillary line. A small hole was made in the pleura, and a pneumothorax slowly produced with collapse of the lung. When the lung was completely collapsed the pleura was incised to the full extent of the wound, and the shrunken lung was pushed away from the mass with retractors. A yellow fluctuating swelling was seen and felt and sinus forceps were gently pushed into it. The pus was evacuated and drainage provided for. Both cases recovered; these were, no doubt, exceptionally favourable cases.

H. S. PENDLEBURY.

NEW GROWTH IN THE MEDIASTINUM.

Iodide of potassium should be always given, I think, in full doses, unless a syphilitic character can be absolutely excluded (Potassii Iodidi, gr. 20 to 30; Spiritus Ammon. Aromat., ♏20; Infusum Calumbæ, ad ℥j; well diluted, thrice a day).

If this is of no avail, or if the tumour is judged to be of lymphosarcomatous nature, as is most often the case, a trial of arsenic should be made in gradually increasing doses until slight symptoms of intolerance, such as nausea or diarrhœa or conjunctivitis, show that the limit has been reached for that patient. After an intermittence of a few days, a slightly smaller dose should be persevered with. (To begin with: Liquoris Arsenicalis, ♏3; Aquam Chloroformi, ad ℥ss [U.S.P. Liquoris Potassii Arsenitis ♏3; Aquæ Chloroformi, ℥ss; Aquam, ad ℥j]; after food; thrice a day. To be increased by ♏1 in each dose every third day.)

The organic compounds containing arsenium ("atoxyl" and "soamin") may be used by intramuscular injection; but their alleged superiority has to be balanced against their dangerous toxic property of setting up peripheral neuritis and blindness.

I am not aware that either X-rays or the application of radium has produced any real benefit in mediastinal growths. On such deep-seated masses, already of considerable size when symptoms of pressure arise, these methods, in our present state of knowledge, cannot be expected to produce any effect.

The treatment of these distressing cases must unfortunately in the main be symptomatic; the relief of useless and harassing cough by opium or its derivatives, perhaps best by heroin hydrochloride in doses of about $\frac{1}{12}$ gr.; of dyspnœa by oxygen and the soothing effect of inhalation of chloroform (20 to 30 min.) or by paracentesis of the pleural cavity if fluid accumulates.

Tracheotomy may be required, but only if obstruction is seen by laryngoscopic examination to be high up and due, for instance, to paralysis of vocal cords or to laryngeal swelling.

Some temporary ease may be afforded by bleedings if there is much venous obstruction, as shown by œdema and distension of veins of the neck.

Eventually morphine will be required, and probably in no other condition can its free use be so clearly justified.

CYRIL OGLE.

DISEASES OF THE CIRCULATORY SYSTEM.

DISEASES OF THE PERICARDIUM.

PERICARDITIS.

The treatment of pericarditis may be considered under the following headings: 1. Rheumatic; 2. Pneumococcic; 3. Purulent; 4. Tuberculous; 5. With kidney disease. The condition rarely stands alone, but as a complication of a general or local state, and its treatment must often be subordinate to that of the disease with which it is associated.

1. **In Rheumatism.**—This is the commonest cause of pericarditis, even when there is no other of the ordinary manifestations of rheumatism. Considerable difference of opinion has existed as to whether in acute rheumatism, when pericarditis has arisen, it is advisable on that account to relinquish the administration of salicylate and alkali on the ground that such drugs are depressing to the heart. It would seem, however, to be true that any cardiac depression which may arise is really due to the rheumatic poison acting, as it always does, on the heart and not to salicylate and alkali. If this is so, it is more rational to persevere with general treatment by the drugs, which have an obvious effect on the rheumatic poison, as shown by reduction of temperature, limitation of synovial inflammation, and perhaps a diminished liability to cardiac implication. It is, I am sure, good practice to continue with such a combination as: Sodii Salicylatis, 20 gr.; Potassii Citratis, ʒj; Syrupi Aurantii, ʒj; Aquam Chloroformi, ad ℥j; [U.S.P. Sodii Salicylatis, 20 gr.; Potassii Citratis, ʒj; Syrupi Aurantii, ʒj; Aquæ Chloroformi, ℥ss; Aquam, ad ℥j] given every three hours, which would equal 160 gr. of salicylate in the twenty-four hours; for a child a corresponding or even larger dosage in proportion to the age; for instance, for a child of seven to ten years doses of 10 gr. amounting to 100 gr. in the twenty-four hours, with 20 gr. of citrate in each dose. These doses of citrate will usually keep the urine alkaline, a point to be aimed at, as an index of the efficiency of the alkaline treatment. The use of neutral citrates of

potash or of soda, which become bicarbonates in the tissues of the body, is preferable to the introduction of large doses of alkaline salts, such as the bicarbonates, into the stomach. It may even be advisable to give salicylate in still higher dosage, as advocated by Dr. Lees, who regards pericarditis as often one of the most malignant manifestations of rheumatism and to be treated by large and increasing doses of salicylate, together with double the amount of alkali (sodii bicarb.) contained in each dose.[1]

The *diet* should be milk and farinaceous food. A daily action of the bowels should be secured, and especially is this necessary when full doses of salicylate are being given, as otherwise toxic symptoms may arise.

If it seems necessary for special weakness of cardiac action, *stimulants* can be given, either combined with such a mixture or separately, such as ammonium carbonate, spiritus etheris or brandy.

I think it is always well to apply four or five *leeches* to the pericardium or two for a child. There is not a more certain therapeutic result than the relief of pain in pleurisy by the abstraction of blood by leeches applied over the seat of inflammation.

It is true that in pericarditis there is no pain as a rule. This is a very striking fact. There may be, even in the earlier stages, some tightness and cardiac distress with a tumbling action of the heart. But apart from the question of such symptoms or of pain, it is reasonable to believe that a real and beneficial effect may be produced on the underlying inflammatory condition, as there obviously is in the case of pleurisy, by the use of leeches. The two conditions are analogous. The skin and the underlying inflamed sac are, in each case, supplied by the same blood-vessel, so that removal of blood by the skin would also tap the blood and lymph supply of the synovial membrane beneath.

An ice-bag swung from a cradle or other support and touching the bare skin of the cardiac region will be of use in quieting turbulent action and distress, and may have some influence in limiting inflammation. The bag may be applied continuously, with a packing of lint around it where it touches the chest, to absorb condensed moisture. Care should be taken, at the same time, to keep the extremities of the patient warm, by hot bottles if necessary. Another method of application is the intermittent one, of leaving the ice-bag on the chest for half an hour at a time, to be followed by hot applications for an equal period, with the view that such a proceeding will cause a reflex vasomotor contraction of the blood-vessels supplying the pericardium and so check effusion.

More valuable than anything is *opium* when real distress, irregular cardiac action and sleeplessness are present, given in the form of laudanum or pilula saponis or pulvis ipecac. comp., with due caution, and in the case of children in much diminished proportional dosage and using a liquid preparation by preference.

The præcordial dulness should be carefully mapped out day by day, keeping in mind that the increase of dulness usually indicates dilatation of the heart due to the rheumatic poison, rather than a great increase of exudation into the sac, and that the natural course of rheumatic pericarditis is for the area of dulness to increase to perhaps a considerable extent, the friction still remaining audible and then gradually to contract as the heart regains its tone and the two surfaces become adherent, after absorption of any fluid there may be. Such is the usual course of rheumatic pericarditis.

Nevertheless, a careful watch must be maintained, for in *rare* cases it may become necessary to relieve the heart of pressure by aspiration or even by thorough drainage of the pericardium : (1) If symptoms of dyspnœa and cardiac failure are urgent ; (2) If a reasonable probability exists, from physical signs, that such symptoms are due to the mechanical hampering of the heart by the pressure of exudation distending the pericardial sac. Such signs might include the following : A large area of dulness extending to the right in the fifth right intercostal space; to the left beyond the apex beat, if it can be located; upwards in the second and third left spaces, provided that no pulsation can be felt there. Great muffling of heart's sounds and feebleness of beat. Evidence of collapsed lung at the back of the chest, on the left side. Distended, immobile, jugular veins. By X-ray examination, a globular shadow, without movement.

No operation on the pericardium, neither paracentesis nor incision, can be contemplated with the confidence which one feels in attacking the pleural cavity that such operation is virtually free from risk, even if the diagnosis of the conditions which seem to call for operation be faulty. If operative measures are clearly called for and if the aid of a skilled surgeon is available, I do not think that there can be much doubt but that the best course to pursue, even in rheumatic pericarditis, is for him to explore the pericardium by carefully cutting down upon it, and if fluid and masses of fibrin are found, to remove them both and insert a drainage tube. Probably the best route is by an incision close to the seventh costal cartilage in the epigastrium (*vide* remarks on operation in Pneumococcic Pericarditis).

Such a proceeding would seem to be less open to the danger of injury, by laceration of the heart, than is paracentesis; for almost always there is a doubt whether the condition present is one of effusion or of dilated heart, as the chief factor. Moreover, if effusion is really present in dangerous amount, there is a far greater certainty of discovering it and of removing both serum and clogging masses of fibrin by such a measure; more especially if the opening into the pericardium is made in its most dependent part, where adhesions are least likely to be present.

Paracentesis, however, may be the only possible proceeding in cases of urgency, so that the details of this method should be kept in mind. The two spots most suitable for the introduction of the needle are: (1) The fifth space on the left side, at 2½ inches or more from the mid-line of the sternum, in a normal adult; (2) high up in the epigastrium in the left costo-xiphoid angle. The patient should be nearly recumbent, so that the heart may be as far back as possible. A sharp, hollow needle of moderate size (about $\frac{1}{20}$ inch in diameter) should be used, and not a trocar and cannula. The needle should be introduced by steady pressure, without jerk. As soon as the point is through the skin the aspirator should be attached and suction maintained; the needle should then be steadily but slowly pushed onwards until evidence of the fluid be obtained in the small piece of glass tubing or "index" of the aspirator. If the fifth space is chosen the direction should be backwards and then somewhat downwards and inwards; if the costo-xiphoid angle, the needle should be introduced as high up as possible, close to the xiphoid cartilage and touching the sternum. It should be directed at first backwards and then sharply upwards and inwards, so as to be close to the back of the sternum. The depth, in the normal adult, to which the needle may be introduced, should not exceed 2½ inches.

Pericarditis as a part of rheumatism, therefore, does not usually demand any very active treatment, except in those rare cases where mechanical relief from exudation is called for; nor does it materially influence the general outlook, as a rule. Nevertheless, not infrequently, especially in children, grave symptoms, such as vomiting, orthopnœa, and failure of circulation, with a fatal ending, are seen; but these results are to be attributed to myocarditis and to cardiac dilatation rather than to the concomitant pericarditis, and treatment must be directed to the heart and will include cardiac tonics and stimulants and, perhaps, bleeding, if there is evidence of much distension and commencing failure of the right side of the heart.

2. **Infection with the Pneumococcus.**—*a. In Lobar Pneumonia.*—Constant watch should be kept in lobar pneumonia for the

detection of pericardial friction, from the point of view of prognosis. A fatal ending may almost invariably be anticipated if pericarditis arises. The complication is, however, often overlooked. If diagnosed, no special treatment is indicated during the acute phase of pneumonia beyond that applicable to the general condition of the patient and in particular to the tendency to cardiac failure, which is, no doubt, much accentuated by the pericarditis. Such means as cold sponging, if the temperature rules high, frequent inhalation of warmed oxygen, the regular administration of strychnine or caffein hypodermically and old brandy by the mouth, should be resorted to, with the hope of maintaining cardiac power until the crisis: Caffein., gr. 3; Sodii Salicylat., gr. 2; Aquæ Destillatæ, ℳ10; every four hours, subcutaneously. Four or five leeches may also be applied over the heart's area.

Another reason for repeated examination of the præcordium, in a patient with lobar pneumonia, is, that in such infective forms of pericarditis the friction may be very transitory, for the exudation is apt to become purulent and then friction disappears. If friction sound has been overlooked during the short time it could have been heard, the sure detection of pericardial exudation becomes extremely difficult; since an enlarged dulness, which may not be extensive, a muffling of heart's sounds and feebleness of pulse might suggest a dilated or degenerated heart rather than a purulent pericarditis.

In rare cases, for instance when the pericarditis sets in late in the course of the pneumonia, the patient may survive the crisis and a pericardial effusion of infected lymph and pus remain, friction being absent. A condition may thus exist analogous to an empyema following acute pneumonia; that is to say, a purulent or semi-purulent collection, infected with pneumococci and perhaps now the chief or only cause of illness. If, by careful observation of the præcordium and heart throughout the course of the disease, such a state of things is inferred, with some certainty, to exist, it is clearly necessary to call in a skilled surgeon to explore the pericardium, and if purulent material is found in it to cleanse it and drain it efficiently. Such cases are rare and their detection difficult, but their occurrence should always be kept in mind towards the crisis of pneumonia and after it during an imperfect convalescence.

Operation and drainage can probably be best done by incision in the epigastrium close to the seventh costal cartilage in the costo-xiphoid angle, as at this spot the pericardium can be entered in its most dependent part, and the back as well as the front of the sac and heart can be explored and cleansed. Drainage also is uninterrupted, and from the lowest part and the left pleura is not liable to damage (*see* Ogle and Allingham,[2] and discussion at the Royal Society of Medicine on Pericardial Effusion[3]).

b. In the *pneumococcus infection of infants*, with or without broncho-pneumonia; but, when present, almost always in association with empyema, perhaps loculated and treated or as yet untreated. Here, again, the diagnosis of the pericarditis is exceedingly difficult; the condition is either not thought of or the signs are ambiguous, especially as friction may be quite absent, if purulent material is present; the course is often very prolonged. If a fair degree of certainty is attained that purulent pericarditis is present, exploration is indicated, by incision rather than puncture, as the infected material is frequently in pockets amongst adhesions and as drainage is essential.

It is possible that *pneumococcus vaccine treatment* might be of value; but if the suspicion of such an infection of the pericardium is a strong one, from concurrence of signs, symptoms and pleural condition, it would probably be best to have the pericardium opened, even though it be but an exploratory operation. A harmless exploration of this kind is referred to in the discussion on pericardial effusion at the Medical Section of the Royal Society of Medicine, in the case of a boy æt. four years (No. 4 in the list of operations by the epigastric route[4]).

3. **Purulent Pericarditis.**—Although a purulent pericarditis can be usually traced from concomitant conditions to infection with pneumococci or to pyogenic organisms in pyæmia, cases are sometimes met with which have been called "idiopathic," where a distension of the pericardium exists, apparently as the sole pathological process, the exudate being purulent and the sac often considerably thickened. It is possible that such a condition is in reality infected from an adjacent collection of inspissated material. the residual evidence of an old pleurisy near the heart, pneumococcic in origin. Some examples are no doubt tuberculous.

The diagnosis would rest on the signs of a distended pericardium and on the results of paracentesis. If pus is demonstrated the treatment is one of free incision and drainage, although there are records of cure by repeated tapping (*see* considerations affecting methods of operation in rheumatic and pneumococcic pericarditis).

4. **Tuberculous Pericarditis.**—Apart from cases where a collection of tuberculous puriform matter has formed in the pericardium, I have come across several patients in whom a symptom of mere discomfort, referred to the præcordium or more frequently to the epigastrium, has been the only complaint; but on examina-

tion a well-defined pericardial rub has been heard. No evidence could be found, either in the present state or in the history, to suggest rheumatism. The general physique and aspect were not robust, but a temperature slightly raised and a pulse rate a little quickened were the only symptoms or signs apart from the pericarditis which might indicate ill-health.

It would be well in these cases of dry pericarditis to suspect tubercle as the cause. One might apply the tuberculin skin reaction (Von Pirquet), or during convalescence have the opsonic index estimated during rest and after varying degrees of exertion, in order to confirm this suspicion. In these cases the treatment proper for active tuberculous conditions should be enforced; feeding, pure air and complete rest for some months; the daily life to be subsequently regulated on the assumption that resistance to tubercle is defective, and that open-air and good nutrition are therefore essential.

5. **Pericarditis with Kidney Disease.**—In the later stages of granular kidney a pericarditis may arise, usually dry. The prognosis is almost always a fatal one within a short time from uræmia or cardiac failure; the pericarditis may be regarded as merely a terminal event.

No special treatment should be directed to the pericardium, but every effort should be made to prolong life by the elimination of toxic bodies by purgation, and especially by sweating, and, by sustaining the heart's strength, and therefore the general circulation, to promote the flow of urine. A vapour or hot-air bath every other day, free action of the bowels by salines, such as sodium sulphate or one of the mineral waters, and the cautious use of digitalis and gin, if circulatory stimulants are called for, should be tried.

HYDROPERICARDIUM.

Serum may collect in the pericardium as part of general dropsy in primary disease of the heart or in the consecutive cardiac failure of renal disease. It is difficult to estimate its importance; for although the amount may be large its collection is, as a rule, gradual, and therefore actual pressure is probably small. The treatment would be that which usually leads to the disappearance of general cardiac dropsy, rest in bed, the use, perhaps, of diuretics (of which one of the best is theocine-sodium-acetate 5 to 8 gr. in solution), and certainly of trustworthy preparations of digitalis or strophanthus, in adequate dosage (digalen or Nativelle's digitalin or tincture of digitalis from a good source).

Occasionally, however, a non-inflammatory, serous exudation may arise as an independent condition, and might perhaps be compared to a hydrocele.

By impeding the heart's action a secondary œdema of the body, dyspnœa and albuminuria may be set up, closely simulating renal disease or a dilated heart. If such a condition of pericardial distension is diagnosed, it is obvious that paracentesis of the pericardium is called for; or even free drainage, if the fluid collects again and again (*see* remarks on rheumatic and pneumococcic pericarditis in relation to operation). In these exceptional cases the relief of symptoms and restoration to health may be rapid and satisfactory (as in a case reported by Dr. Latham and Mr. Pendlebury[5]).

CHRONIC MEDIASTINO-PERICARDITIS AND ADHERENT PERICARDIUM.

In this disorder there is not only adhesion of the two layers of the pericardium, but fixation of the heart with consequent enlargement and ultimate embarrassment and tendency to failure, due to external adhesion to sternum, ribs, diaphragm and spinal column, by a mass of fibrous tissue (*see* Harris[6]). Such a condition in a marked degree does not often arise from true rheumatism, or rather one would say that when "adherent heart" is present from repeated attacks of rheumatic pericarditis the concomitant valve lesions are of equal or more importance in the disability of the heart. Some of these cases with extensive præcordial dulness, systolic retraction of epigastrium and intercostal spaces, inspiratory filling of jugular veins and cardiac enfeeblement, are associated with chronic and recurrent inflammation in other serous sacs, the pleura and peritoneum, and with caseating glands. Such are often tuberculous. The origin of others is obscure.

Patients with heart hampered by pericardial adhesions will require a routine of life applicable to cardiac invalids. I have seen great improvement when compensation has failed from time to time by the proper use of drugs of the digitalis type, although it is obtained with greater difficulty and proves of a more transitory nature than in ordinary heart disease. The loss of support normally afforded to the heart by the pericardium, which has been spoilt and stretched in past inflammation, and the resistance to the tone and contractions of the heart caused by the fibrous adhesions to surrounding structures, would account for this difficulty.

Apart from treatment directed to the cardiac muscle, perhaps the use of "fibrolysin" (thiosinamine and sodium salicylate in solution) might seem worthy of trial. I do not know that it has been used for pathological fibrosis in this position, and the evidence of its value in causing softening and disappearance of abnormal fibrous tissue in general is conflicting. The dosage is about 40 min. (an ampule of 2·3 cubic centimètres, Merk) injected deeply into the muscle of the buttock once or even twice a week.

There is also the question in any individual case of the possibility of improvement by surgical measures which will give the heart more free play in spite of the adhesion. The operation of "cardiolysis," advocated by Brauer,[7] consists essentially in resection of several costal cartilages on the left side, so that a flexible membrane, consisting of the soft tissues of the chest wall, replaces the rigid resistance of cartilages and ribs, and thus the heart, although still adherent, is enabled to contract more efficiently. It is claimed also for the operation that the movements of the diaphragm can afterwards be executed with greater freedom, that the respiration, therefore, is easier and fuller, and that the entry of the blood from the venæ cavæ into the heart is less impeded. Several examples of operation of this nature have been reported,[8] and with fairly satisfactory results as regards diminution of dyspnœa and œdema and of enlargement of the liver (*see* article on Surgical Treatment of Pericarditis).

CYRIL OGLE.

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SURGICAL TREATMENT OF PERICARDITIS.

Paracentesis Pericardii.—The spot chosen for introduction of the aspirating needle, of not less than $\frac{1}{10}$ inch in diameter, is in the fifth left interspace 1 inch from the margin of the sternum. By choosing this spot injury to the pleura and wounding of the internal mammary artery will be avoided. The most careful aseptic preparations should be made, and it is wise to incise the skin with a sharp tenotome before introducing the needle.

A very slight negative pressure is produced in the aspirating bottle, and as the needle is being steadily pushed in the first few drops of fluid should be looked for, so as to avoid wounding the heart. After sufficient fluid has been withdrawn the tiny wound is closed with a collodion dressing.

Drainage of the Pericardium is indicated in purulent pericarditis and recurrent hydro-pericardium.

The patient lies on his back with the head and shoulders raised to the most comfortable position for the patient, and very light anæsthesia is induced.

A vertical incision, about 4 or 5 inches long, is made with its centre at the lower border of the seventh left costal cartilage, parallel with and 1 inch from the left border of the sternum. The skin and fascia are reflected inwards and outwards, and the muscles detached in the same direction from the sixth and seventh costal cartilage.

Two inches of the seventh costal cartilage are removed and the cellular interval (" costo-xiphoid " space), containing the junction of the internal mammary and superior epigastric arteries, is broken into. If the vessels are in the way they may be divided between two clips and held aside.

The tissues are carefully pushed upwards, and inwards and outwards until the pericardium is exposed, and incised at a level just above the base of the ensiform cartilage. In a few cases the pleura may be wounded, in which case the hole is seized with forceps and ligatured. If there is not sufficient room for a finger or two to be introduced to explore the pericardial cavity 2 inches of the sixth rib may be excised, but as a rule this is unnecessary.

When the pus has been evacuated a large drainage tube is introduced and stitched to the skin, care being taken that it only just projects into the pericardial cavity. By this operation drainage is ensured from the most dependent approachable position, and the condition of the heart and pericardium both in front and behind can be thoroughly explored, especially in children.

After-treatment consists in general medical treatment. The patient should be raised into the most comfortable position. Irrigation is not advisable.

Pericardial Adhesions.—Here the parietal and visceral pericardium has become more or less firmly adherent and the parietal layer is again connected by adhesions to the surrounding parts including the chest wall. This fixation places the heart at a mechanical disadvantage and makes the patient a permanent invalid. The writer has undertaken the above operation for this condition with good results in two cases where the adhesions were of very recent origin. The following operation has been described for this condition by Brauer and others:

Cardiolysis.—A large flap, containing the tissues down to the ribs and sternum with its base corresponding to a line just beyond the right border of the sternum, is raised, so as to expose the sternum from its junction with the lower border of the third costal cartilages above, to the sixth costal cartilage below; and also to expose the left fourth and fifth cartilages as far outwards as their costo-chondral joints. The sternum is carefully cut across below the third costal cartilage and above the sixth with a Gigli's saw. The left fourth and fifth cartilages are detached from their junction with these ribs, and the right fourth and fifth cartilages are detached from their junction with the sternum.

The piece of sternum with the left fourth and fifth costal cartilages attached is then cautiously separated from the deeper structures and removed.

The large flap is then replaced, sutured along the line of incision, and a drain is left in.

This operation has been undertaken in order to free the heart from its fixation to the most immovable part of its surroundings, and although only a few cases have been reported its results have been somewhat encouraging.

H. S. PENDLEBURY.

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DISEASES AND AFFECTIONS OF THE HEART.

ACUTE ENDOCARDITIS.

Acute endocarditis is usually the result of acute rheumatism, and less frequently of any other acute fever, such as scarlet fever. If treatment is injudicious, or sometimes in spite of treatment, there is a tendency to relapse. In all cases one of the chief determining factors is the presence of micro-organisms, which infect the tissues of the valves. When the virulence of these organisms is marked in comparison to the resistance of the patient, the toxic symptoms are more definite, and high fever is a feature of the condition. Such cases are usually regarded as being of a separate type, and are considered under the heading of acute infective endocarditis. This sub-division is an inaccurate one, but it is useful in so far as the clinical aspects and prospects of recovery are concerned. The same principles, however, underlie all cases of acute endocarditis, for all are examples of an infective process, although some cases are more acute examples than others. In all an endeavour should be made, if necessary, on several occasions, to isolate any micro-organisms which may be present in the blood. If such an attempt is successful, treatment with a suitable vaccine, together in some cases with a serum, should be carried out on the lines laid down in the article on Acute Infective Endocarditis.

The onset of acute endocarditis in the course of rheumatic fever or other conditions may often be prevented by adequate treatment. This subject is considered in the article dealing with Acute Rheumatic Fever. When endocarditis is established, our aim must be to bring about adequate compensation. In many instances this involves prolonged treatment. No sacrifice can be too great during the establishment of compensation, for on it depend the comfort and capacity for work of the patient in after life. An attempt to return to ordinary life too soon carries the penalty of more or less constant ill-health, owing to the frequency with which the heart fails to meet the demands placed upon it. In the establishment of adequate compensation our chief endeavour is to relieve the heart from unnecessary strain and work. Our sheet-anchor is *absolute rest* in bed. This portion of the subject is considered in more detail below. In addition we protect our patient from excitement and mental worry. We place him under good hygienic conditions, and in other ways assist nature as far as possible. We avoid the use of drugs, such as digitalis, which increase the blood-pressure and throw extra work upon the heart. It is doubtful whether the careful use of salicylates affects the heart-muscle in many cases, but it is held by some authorities that their continuous use may favour further dilatation. We avoid constipation, preferably by blue pill and salines, as we know that this complication tends to raise the blood-pressure.

Diet.—This should be light and solid, if possible. Meat and meat extractives tend to increase the blood-pressure, and should be used sparingly. The fluids taken are best limited to 2 pints a day, as excess of fluid also increases the work of the heart. The best fluid is pure water. Stimulants should not be prescribed, unless we are dealing with one of the severer forms of the disease in which there is much exhaustion and very rapid action of the heart.

Medicinal Measures.—A mild quinine tonic is often useful. As citric acid tends to lessen the coagulability of the blood, its use may prevent the deposition of fibrin or the formation of thrombi: Acid. citrici gr. 20; quin. sulph. gr. 1; aq. destill., ad oz.ss, may be mixed with pot. bicarb. gr. 20; ammon. carb. gr. 2; sp. chloroform. ♏10; aq. destill., ad oz.ss; to be taken whilst effervescing thrice daily. If anæmia is marked, iron or arsenic may be added. Strychnine and other stimulants, such as camphor, are usually credited with helping the heart-muscle in such conditions, and clinical evidence would tend to support this view. With regard to the former drug, experimental evidence does not support clinical evidence. In any case the use of such stimulants is contra-indicated unless marked exhaustion is present. As already stated, digitalis should not be given in the majority of cases. When, however, the process of compensation has made some progress, that is to say, when convalescence is becoming established, the judicious use of digitalis is sometimes valuable.

Rest and Movement.—In the majority of cases in which endocarditis is present it is wise that complete rest in bed should be insisted on for three months. There should then be a period of rest on a couch for a further three months, with suitable massage and resistance movements. The movements of the patient should be carefully supervised for a further six months. These are general rules, and, of course, each individual case must be treated according to the clinical indications. A simple, straightforward case of mitral disease may allow a more rapid return to movement

A case in which aortic regurgitation is present, or in which pericarditis has occurred, will require a longer time. In all cases the after-results depend on not allowing the work of the heart to be increased until the muscle is able to bear the strain placed upon it. When compensation appears to have been established and the pulse is quiet, an extra pillow may be allowed. Later the back may be raised a little more. If such changes lead to any increase of the pulse-rate or any cardiac distress, compensation has not occurred, and we must return to a lower grade of exertion and wait until the time appears ripe for a further experiment. In some cases light massage and resistance movements are of great value at the end of about two months. In other cases we have to wait longer before we can safely use these measures. Here, again, the rate of the pulse is our main guide as to the value of the treatment. After a period of rest on a couch the patient may try the effect of sitting up. The massage and resistance movements may now be increased. Later slight walking exercise may be allowed. In every stage symptoms of cardiac distress, such as increased frequency of the pulse, palpitation, breathlessness, mean that we are proceeding too rapidly. During this treatment and for some time later the patient must avoid any possible excess of diet or of alcohol. Similarly, constipation, anæmia, fatigue or exposure to conditions likely to cause bronchitis are to be guarded against.

In some cases in which there is difficulty in maintaining compensation, Nauheim baths, as used in the Schott-Nauheim treatment, may be of considerable value.

After-care.—In the majority of instances compensation occurs under prolonged rest. When it is so well established that exercise is permitted, definite rules must be laid down. Too little exercise is almost as bad as too much. Exercise in moderation is of great service, as it tends to keep up the tone of the heart-muscle. Practically any exercise which does not cause breathlessness, and which is not followed by a sense of fatigue, may be allowed when compensation has occurred. Thus lawn-tennis, riding, cycling, swimming, dancing, cricket, racquets, hunting, fencing may all be permitted within moderate limits. Severe strain, such as is incurred in racing or football, should be forbidden. In walking, it is well to avoid a hill at the end of the walk. The patient should be examined at intervals, so that any excess may be stopped before it has brought about failure of compensation. In children a sharp look-out should be kept for any rheumatic pains, and if such occur the child must rest in bed and receive immediate treatment. When patients with compensated heart disease suffer from an attack of influenza, bronchitis or acute fever, rest should again be prolonged, or otherwise failure of compensation is certain to recur.

Complications.—When there is much *pre-cordial pain* or distress a full dose of Dover's powder (10 to 15 gr.) should be given, or in a strong subject $\frac{1}{3}$ gr. of morphia, together with liq. strychnin. (♏4) [U.S.P. strychnin. hydrochlor., gr. $\frac{1}{28}$], and a hot linseed poultice applied to the precordium. If this fails, the continuous use of the ice-bag may be tried, but the bag should be replenished every two hours, and its weight must not rest on the chest. If the pain is less marked and somewhat chronic the effect of a blister should be tried. *Sleeplessness* is best met by full doses of paraldehyde (ʒj to ʒij) or by ammonium bromide, but it is not infrequently necessary to use morphia. If *vomiting* occurs, food should be withheld for six to twelve hours, and then small feeds of whey or skim-milk or albumin-water given, with an occasional spoonful of iced brandy and soda-water. If there is much *dyspnœa* and evidence of *dilatation of the right heart,* together with a rapid pulse, free stimulation must be prescribed. Oxygen is useful in this condition, and it may be necessary to give digitalis.

ARTHUR LATHAM.

GENERAL TREATMENT OF DISEASES AND AFFECTIONS OF THE HEART.

INTRODUCTION.

What to Treat.—Before entering upon the consideration of the treatment of affections of the heart, it is necessary to have in the mind a clear idea of what we aim at in treating any given individual. This is all the more necessary if we desire to treat the patient on a rational system, for it will be found that the careful analysis in each case of the symptoms and of the circumstances that have led to the heart failure, vary so much that no two patients present the same conditions, and therefore each patient has to be treated with reference to his special requirements. Moreover, there are many obscure phenomena which nevertheless are often the object towards which the treatment is directed, though in themselves these phenomena are not the signs of disease nor suitable indications for treatment. We are therefore bound to search for some general principle that will guide us in the appreciation of the peculiarities of each individual and help us to estimate the value in treatment of any given symptom whose nature we may not understand.

Before setting forth the indications for recognising the significance of symptoms and their relation to heart failure and to treatment it is necessary to point out that many prevalent ideas as to the need for treatment have to be materially modified. Up till late years so very little was known of the mechanism by which many cardiac phenomena were produced and their bearing upon the heart's efficiency that the conception of heart failure and the manner of its production have been imperfectly realised. As practising physicians, we constantly meet patients who are being subjected to strenuous and irksome treatment, because of the presence of some symptom, which, being considered abnormal, appears in consequence a suitable object towards which treatment should be directed. Such a symptom in reality may indicate no harm in the present, nor forbode any danger in the future, while in some instances, the supposed abnormality may actually be an indication of a sound and healthy heart.

From such considerations as these it has been necessary, in ascertaining the significance of many heart symptoms, to watch individuals for many years, in order to find out the bearing the abnormal symptoms (whether their mechanism be understood or not) may have upon the patient's future, and what indications they may give for treatment. Hence the determination of the value of symptoms plays a very important part in seeking for some definite principle on which to base a line of treatment. In order to give a clear idea of what the principle may be it is necessary to understand what heart failure is, seeing that the reason for treatment is in many cases due to the fact that the heart cannot maintain an efficient circulation. Before dealing with treatment, it is necessary to propound the following conception of heart failure, which in the writer's experience has been found universally applicable, and which will be found more or less consistent with the experience of every physician who has given thought to the matter.

HEART FAILURE.

The object of the circulation is the supply to the tissues of a material capable of nourishing them and the removal of such waste products as can enter the circulation. The heart and blood-vessels are constructed specially to favour this object. The heart muscle supplies the force which maintains the circulation and the blood vessels are so constructed as to facilitate the work of the heart. Any disturbance in that adjustment must at once entail more work upon the heart muscle, inasmuch as a departure from the normal means the embarrassment of the heart in its work. From this consideration it will be seen that the essential factor in maintaining the circulation is the heart muscle, and any morbid process usually affects the circulation only by embarrassing the work of the heart muscle.

The force inherent in the heart muscle may be considered for practical purposes to be composed of two parts, viz., a part which is employed to maintain an efficient circulation when the body is at rest, and which therefore may be called the "rest force." The rest force is the minimal which the heart can exert to maintain the circulation at a level consistent with life. Any impairment of this leads invariably to a fatal issue. The second part of the heart's force is that which is called upon when the body makes some effort. Whilst the body is at rest this part is not exercised, but it is by the presence of this force that we are able to undertake with ease all forms of effort. Inasmuch as this part of the heart's force is only used when exertion is made, it may be called the "work force" of the heart. The reason for this division of the heart's power into the "rest force" and the "work force" is that it enables us to understand better what heart failure is. When we reflect that any disturbance of the circulatory mechanism implies an embarrassment of the heart muscle in its work we shall realise that heart failure means an inability of the heart muscle to overcome successfully the obstacles opposing its work. The disturbances of the circulatory mechanism may be of a very varied character and may arise from a great variety of causes, and it is from this standpoint that the bearing of all seeming abnormalities upon treatment should be considered. Thus valvular defects should be studied not as specific affections to be treated in themselves but as sources of embarrassment of the heart muscle in its work or as indications of morbid processes, which may have extended to and affected the walls of the heart or blood-vessels, such as the aorta and coronary arteries. In like manner, before treating irregular action of the heart, it should be considered whether such irregularity embarrasses the heart in its work, as well as from the standpoint of the condition causing the irregularity. Arterial degeneration and high blood pressure, while requiring full consideration, should also be viewed as agents tending to upset the normal adjustment of the factors that carry on the circulation. The possibility of inherent defects in the muscle wall itself should be considered in all cases, as they have a most important bearing on the heart's efficiency. Overwork, bodily or mental, too little time given for rest and restoration of the heart's strength, worry, sleeplessness, the reaction of the nervous system and other organs upon the heart, should all be taken into account when the factors producing heart failure are being considered.

Heart failure invariably starts in the first instance by an exhaustion of the work force. The exhaustion is slight at first, and by the persistence of the factors inducing it and its indications being ignored it proceeds apace, until after a period, long or short, the rest force is encroached upon, and with the exhaustion of the rest force a point of danger to the life of the individual is reached.

The first sign of heart failure is invariably a subjective one, although it may for a time be ignored. The patient's attention is drawn first to his condition by some feeling of distress in the performance of some act he was wont to do without discomfort. It is the limitation of the field of cardiac response which is the first and dominant feature in all forms of heart failure, and it is by the due appreciation of the patient's sensations that the physician obtains the most reliable information about the conditions of the heart's strength. The standard by which the heart's strength is measured is peculiar to the individual. Each one knows the amount of effort he can put forth without distress, and this is the only practical standard. The kind of distress called forth varies, breathlessness, palpitation, sense of exhaustion or suffocation and pain are the more common sensations experienced.

By the time objective signs of heart failure have arisen, such as dropsy, laboured breathing when at rest or after slight exertion, increased rate, and dilatation, the heart failure has proceeded a long way. If such objective signs persist when the body is at rest, then the work force is practically spent and the rest force is being exhausted.

Difficulty in Estimating the Effects of Remedies.—Whilst the foregoing account deals with actual failure of the heart, it is necessary to recognise the fact, that the majority of "heart" patients whom the physician has to treat suffer only to a slight extent, if at all, from heart failure. Disagreeable sensations may arise, due to, or associated with, some such circulatory condition as palpitation, irregular action, feelings of weakness and faintness, or nervous sensations of various kinds. There may be found a certain limitation of the field of cardiac response, some more or less distinct cardiac abnormality, such as a murmur or an increase in size. In other instances no abnormality can be detected. In every case, however, the heart is considered the organ at fault, and towards its restoration active means are taken. The remedial measures may result in the restoration of the patient to a more healthy condition with the disappearance of disagreeable sensations. If care is not taken to recognise the nature of the complaint and the part played by the various agencies employed which may be successful in these cases, some particular agent may come to be reckoned as valuable in the treatment of all sorts of heart affections.

It is therefore necessary before entering more particularly on the consideration of the agents which can be usefully employed in treating cardiac conditions to glance briefly at certain factors which influence patients and physicians in the selection of cardiac remedies.

The most potent of these factors is suggestion, which is so subtle in its action that neither patient nor physician realises its activity. Reference has just been made to the fact that in many cases the symptoms of the supposed heart affection are dependent on the state of the patient's nervous system, and the treatment by improving the health of the patient dispels these symptoms. In the course of treatment the patient's mode of living may be materially modified in restricting his diet or indulgences or the amount of effort, or in seeking change of scene. To these changes may be added some drug or exercise, or bath, and the resultant improvement is attributed to the special means. In this way numerous special agents have obtained a reputation as being efficacious in treatment. But in addition to this doubtful source of obtaining remedial measures, another is to be found in the nervous condition of the patient. There are many people who imagine they have a cardiac affection, and are in consequence peculiarly apprehensive. Any circumstance which removes that apprehension will at once relieve the patient, who consequently fancies that the relief has been obtained by the specific action of the agent on the cardiac trouble. To discriminate the real from the seeming is a matter of extreme difficulty, particularly when there is a certain degree of heart failure due to some organic lesion of the heart. It has been said with a great deal of truth, that the cardiopath tends to become a neuropath. It is the want of recognition of this fact which misleads the profession in regard to the value of remedies. As an illustration the following experience may be quoted: I have seen at intervals an intelligent man, who suffered from advanced cardiosclerosis and frequent attacks of angina pectoris. Relief from these attacks was always obtained by $\frac{1}{100}$ gr. of nitro-glycerine. He also had at times attacks of dyspnœa, which were rather distressing. He told me that relief from the dyspnœa was always obtained by the use of the nitro-glycerine, although it took half an hour to act. I had ascertained that his attacks of dyspnœa would sometimes stop if he became deeply interested or if he talked. I reasoned with the patient that I was in doubt whether the nitroglycerine could give him relief, stating that the action of the drug was very speedy and I would have expected relief in a few minutes after taking it. However, he was so confident of its good effect that he promised to keep a diary for me of the attacks of dyspnœa. This diary I have before me now and I need only say that it recited the occurrence of two attacks, which were duly relieved half an hour after taking the nitro-glycerine. Then the third attack of dyspnœa was described, for which only a peppermint lozenge was taken and in a quarter of an hour complete relief was obtained. When next I saw the patient and talked over the experience, he remarked that he had a great faith in the efficacy of peppermint. It is scarcely necessary to point out that the infinitesimal quantity of peppermint could only have acted when accompanied by the faith in its activity.

This effect upon the patient of measures *plus* faith is well recognised though not sufficiently discounted. Nay, more, it can be affirmed that the medical profession too often shares the same unconscious deception. It is marvellous that men trained in the exact sciences, and who can reason logically, appear to lose all sense of proportion and reality when they come to deal with remedies that are supposed to affect the organism. The readiness with which statements are accepted, and the entire absence of the critical spirit, have introduced so many so-called cardiac remedies that it is impossible for one individual to determine the efficacy of more than a small number. When the evidence on which many of the remedies are recommended is examined it is found that it is impossible to put the evidence to a test. If one inquires into the proof, it will be found that the proof depends on inference drawn from the improvement in the condition of certain patients when the remedy has been applied, but we often find that at the same time other agents were employed or that the individual was susceptible to suggestion. If, for instance, we inquire into the administration of such a drug as digitalis, whose potency no one would deny, and whose action on the heart and blood-vessels can be accurately measured by various mechanical means, we find the drug recommended in doses so small that by these mechanical means we can get no evidence of its action. Digitalis is recommended in doses of 2 to 5 min. of the tincture and its result is said to be detected by some in a few minutes after the dose and by others after a few hours. When it is pointed out that neither the rate nor the rhythm, nor the size of the heart, nor the blood pressure, is affected by such doses, the answer is that the finger can detect some change in the character of the pulse or of the artery. This being purely personal evidence, cannot be contested, for the observer claims a delicacy in perception denied to ordinary mortals. In like manner strychnine has of late years come to receive such an amount of commendation that the belief in its efficacy amounts almost to a superstition. Yet, given in medicinal doses, it is absolutely without detectable effect upon the heart or blood-vessels experimentally, or in the human subject. No great harm might accrue to these beliefs were it not that it leads to perpetuation of methods of treatment which are vain and valueless. Positive harm does actually occur, for in cases of serious heart failure the belief in these ineffective remedies leads to their employment in *grave* conditions and to the neglect of more efficient measures, so that the patient's life may be put in jeopardy if not sometimes sacrificed. I have repeatedly been called to see patients *in extremis* from the heart failure following after the fibrillation of the auricle (nodal rhythm), when for long periods small doses of digitalis or frequent hypodermic injections of strychnine were given. The immediate prescription of effective doses of digitalis has in many cases improved the patients' condition, so that in a few days they have been out of danger. I shall again revert to this matter in the discussion of the value of drugs.

This aspect of the subject is of further importance in so far as it concerns the advances to be made in the treatment of heart affections. There are many forms of heart trouble for which our present methods are of no avail, but to a great extent medical men are prevented from realising their powerlessness because of the faith in the ineffective procedures, so that, in place of realising our limitations and striving to perfect our methods, writers are too often content to recapitulate an array of methods and remedies which the practitioner in attempting to employ finds to be absolutely useless. If the profession was more conscious of its impotence there would be more hope for advance in treatment.

PRINCIPLES OF TREATMENT.

Bearing in mind the view that heart failure begins by an exhaustion of the work force and is perceived only when exertion is made to the full amount of which the heart is capable, the first duty in treatment is to ascertain what circumstances have induced the heart failure. To this end an inquiry is made into the patient's condition to find out when first he became conscious of the limitations of his cardiac field of response. Then a searching examination is made into the circumstances preceding that period as to the question of overstrain, worry, sleeplessness, and possibility of infection. The inquiry next proceeds to the examination of the circulatory system, and any defect there must be considered from the point of view of whether its presence embarrasses the heart in its work, *e.g.*, a valve defect, degenerated heart muscle, arterial degeneration; or whether its presence indicates some active change going on in the heart, and that the failure has been due to a gradual weakening of the heart from this cause. If the physician is careful to bear in mind that an abnormal sign is not necessarily an evidence in itself of disease, and that it is not the sign which has to be treated, but that the essential aim in the treatment of heart failure is the restoration of the work force of the heart muscle, then he will have a sure guide in applying treatment to the most diverse conditions even when the symptoms are not fully understood. Accordingly, before proceeding to treat the patient, we try to appreciate the value of his symptoms, subjective as well as objective. When we do find some abnormality on physical examination its bearing upon the subjective sensations has to be considered on the lines already laid down.

When we detect some actual cardiac defect, and we recognise that the heart failure is undoubtedly brought about by its presence, then, provided that we cannot remove the actual lesion, the object of treatment is to restore the exhausted muscle and place the patient in such a position that he can lead a life useful and free from discomfort, though hampered by an obstacle to the heart's full efficiency. We should keep steadily before our view the fact that the heart is impaired, and it is vain to attempt to restore the irremediable. This suggestion may seem so self-evident as scarcely to need mention, still less emphasis; but, from practical observation, I feel the necessity of insisting upon it, for patients with an incurable cardiac defect are continually being subjected to treatment whenever they consult a physician and may be found going to health resorts year after year under the impression that in some way or other the defect needs treatment. If the patient had an ankylosed joint, or a wooden leg, it would be recognised that baths or drugs can do little for him, but the thickened edges of a mitral valve are supposed in some way to need constant treatment. The object of treatment should not be to try to remove what cannot be cured but to make the best of what power the heart still possesses. In the nature of things it may be that only a partial restoration of the heart's strength can be looked for, and when we recognise that the full amount is gained, judicious advice as to the future life of the patient may cause him to lead a life, at a lower level it is true, but still useful and interesting, and his years may be prolonged to the allotted span. Many individuals with a work force limited on account of inherent defects in the heart may never suffer from heart failure of any serious moment, and where the lesion is not a progressive one they may suffer little inconvenience provided that their limitations are appreciated by themselves and their medical advisers. It is in these cases that the advice of a wise physician is of great service. The knowledge of how much an individual may do, the permission to do as much as his work force will allow him, without inducing exhaustion, can only be acquired by the full and careful consideration of all the individual symptoms. Much inconvenience may be caused to the patient by taking too grave a view of his cardiac defect and so limiting him far too strictly and hampering him in his life work, and oppressing him needlessly with the supposed gravity of his condition. On the other hand, the pursuits of a man whose heart is embarrassed by a grave defect may imperceptibly call too frequently on the full extent of the work force of the heart, and so gradually lessen the amount until heart failure of a more or less serious degree is induced. The work of man has attained a rough and ready standard in most trades and professions, and the amount is fairly commensurate with the work force of the average healthy man. The man with a cardiac defect is handicapped in the race, and if the handicap is too heavy his endeavour to keep his place is made at the expense of his heart's strength.

I put the matter in this way and dwell upon it with some insistence, because if the physician guides the sufferer in his work, he may give life and hope to many a stricken fellow. Thus, in the early years, after some cardiac lesion following rheumatic fever or other infective complaint, the choice of a profession which will never entail severe bodily exertion may enable the lamed individual to live a useful and contented life. In more advanced years the recognition of some early stages of some progressive lesion as cardiac-sclerosis may enable the physician to advise the patient to avoid certain deleterious influences in his work or mode of life, measures which, while preventing the progressive exhaustion of his work force, may nevertheless enable him to pursue a useful and comfortable existence for an indefinite number of years. So in the many other phases in which a heart trouble may mar a patient's life, as, for instance, the question of pregnancy and its relation to heart trouble, a subject indeed of the first importance but unfortunately too little considered.

It may reasonably be asked *what are the indications which should guide the physician in advising a restricted life ?* No answer can be given of definiteness sufficient to be applicable to every case. It is in this respect that a wise judgment needs to be exercised. Many symptoms are so obscure in their origin, and there is such a tendency in the human mind to see evil in what is not understood, that a very urgent caution has to be given not to attach too grave a significance to any sign or symptom. The more common forms of them I deal with later (*see* Symptoms as indications for treatment). Here I would lay down the general proposition, let no abnormal sign of itself be the reason for giving a prognosis or for subjecting the patient to treatment. A careful search should be made for accompanying symptoms and a careful inquiry into the condition of the work force and the reason for any exhaustion. On the results of such an examination the final decision should be based.

When the heart lesion is not progressive the best line of advice is that the patient should follow his trade or profession and indulge in such exercise as he can in comfort, avoiding all forms of effort that induce distress. When effort that may involve strain has to be undertaken a period of rest should follow, sufficient to permit full recuperation. By this line of conduct the heart itself will benefit by the judicious exercise of its functions, and the patient be freed from the restrictions of an invalid life. When the heart failure persists in spite of restricted effort further measures must be adopted. The period of rest must be increased and remedies that may strengthen the heart administered. The administration of the drugs of the digitalis group may be called for, the special indication being dilatation and increased rate. In acute cases with fever digitalis is ineffective, and treatment should be aimed at the cause of the fever and at giving the heart as little to do as possible. In like manner, when there is evidently a progressive exhaustion of the heart's strength, the amount of effort must be reduced to the lowest possible. When the heart failure is extreme and the rest force is being exhausted, as evidenced by the persistence of symptoms of heart failure when the patient is in bed (dropsy, orthopnœa, etc.), then absolute rest is indicated, and such drugs as digitalis should be pushed until some physiological effect is produced and the treatment of such special symptoms by appropriate remedies (*see* Symptoms as indications for treatment) should be adopted. Sleep must be obtained. The food must be restricted as described under Diet, the bowels must be carefully attended to, and aperients or enemeta given if necessary. If there is much dropsy and congestion of the liver a smart mercurial purge may be of use. If, however, the movement of the bowels induces extreme exhaustion, they had better be left alone for the time being.

REMEDIAL MEASURES.

Rest.—It may seem unnecessary to dwell upon such a well-recognised agent in cardiac treatment as rest were it not for the fact that its effects are seldom appreciated fully. In a great many systems of treatment rest is only one of the factors employed, and the resultant benefit is rarely attributed to the rest but to some other agent that has been employed at the same time, such as baths, movements, drugs, massage, change of residence. Were the value of simple rest to body and mind sufficiently appreciated we should hear less of the vaunted cures by special methods.

In the closer study of the heart as revealed by graphic records we cannot but be struck by the great difference in the vigour with which the heart's functions are performed according to the amount of rest that preceded the exercise of them. It is a well-established fact that after contraction of the heart the power of contracting is for a brief period abolished. When the power begins to return the resultant contraction is at first extremely feeble, but with increased delay there comes an increase in the strength of the contraction. While this is true in regard to all hearts, healthy as well as diseased, in the human heart it is much more readily demonstrated when there is a certain amount of exhaustion. In the form of irregular heart action which shows the pulsus alternans every second beat varies in size, a small beat and a large beat alternating, although the rhythm is perfectly regular. It seems that there is a minute difference in the duration of the beats, the smaller beat lasting a shorter time so that the following diastolic period is slightly lengthened, and, in consequence, the following contraction is more vigorous and lasts longer. Lasting longer, it encroaches upon the following diastolic period, with the result that the subsequent contraction is smaller and shorter in duration. This explanation shows what power is gained by a period of rest that is scarcely appreciable by ordinary methods of measurement. In many cases where the heart is continuously irregular it will be found that the size of the beats has a definite relation to the preceding period of rest. The restorative qualities of rest can also be demonstrated in the case of the rate of passage of the stimulus from auricle to ventricle, in many cases where the function of conduction is depressed the slightest slowing of the heart's rate shortens the interval between the auricular and ventricular systoles.

It is probable that the extraordinarily beneficial action of drugs of the digitalis group is in some measure due to the fact that they induce a marked slowing of the heart's action, so that more rest is obtained for the exhausted muscle.

When a heart is exercised to the exhaustion of its work force, it is absolutely necessary that a period of rest should follow of sufficient length to permit the full restoration of the work force. If the rest is not sufficient the exhaustion gradually becomes more readily induced till objective signs of heart failure are perceived. Recognising thus the potency of rest in maintaining the working power of the heart, we can readily appreciate its beneficial effect in treating exhaustion. We have therefore to consider how best the necessary rest can be attained. In many cases, by diminishing the amount of the day's labour, a longer period of rest may be obtained which is sufficient for the purpose of restoring the exhausted heart. Other means for obtaining rest for the heart can be employed in protecting the heart from undue excitement. Bodily effort is not the only cause of exhaustion. In many people an irritable nervous mechanism playing upon the heart induces an effect that is peculiarly exhausting. In many sensitive nervous people the readiness with which the heart responds to stimulation constitutes the real source of trouble, and in time leads to very marked exhaustion, especially if the heart is affected by some organic lesion. In these cases more good can be done by treating the nervous element in the case by finding out and removing the cause of the excitability or by removing the patient to more congenial surroundings, as to an environment that will interest without exciting, or by dulling the nervous system by such drugs as the bromides. Worry, business or domestic, plays an important part in depressing the heart's functions, and when it is not possible to free the patient from it altogether steps should be taken to mitigate it as far as possible. Other forms of mental disquiet should also be inquired into and treated, for sleeplessness, disturbed sleep and unpleasant dreams do much to hinder a patient's recovery and aggravate the heart failure. It may be said with truth that no heart can regain its full strength if sufficient sleep is not obtained. The various remedies for obtaining sleep will be considered later.

These suggestions on rest are applicable to the milder forms of heart failure. Rest is of far greater value in cases of extreme heart failure where the work force is practically exhausted and the rest force is encroached upon, *i.e.*, the exhaustion has become so great that the symptoms do not abate when the patient is laid in bed. While this condition demands the exhibition of other remedies than that of rest, yet rest itself is of the utmost value. In these extreme cases it is not always easy to hit upon the position the body should occupy that is most beneficial. As a rule, the patient's sensations are a very good guide. It may be that lying in bed causes such distress that the patient is not at ease unless he assumes some position which he finds removes the discomfort, as in sitting in a chair or leaning forward on a support. Such individuals should be permitted to assume the position in which they find the most comfort or least discomfort, as it favours the circulation in those regions which induce the distress, as in the lungs or brain, though it may militate against the circulation in other regions, as in the legs. When dropsy tends to increase in such cases, careful change in position, raising the legs as high as possible, deft bandaging and massage may do much to diminish the swelling, other treatment being at the same time directed to the dropsy and heart condition. When the failure is not so extreme, and particularly if there is dropsy, complete rest in bed is of the greatest service and many cases recover without other means. If necessary, the shoulders should be raised by pillows or a bed rest to such a height as may prevent attacks of dyspnœa coming on during sleep.

Diet.—A pressing consideration that arises, more particularly in the severer cases of heart failure, is the question of diet. The subject is forced upon every physician, and many have elaborated special systems. Many dietaries are based on theoretical considerations, or on the physician's own personal experience. When it is borne in mind that we still know very little about the factors concerned in metabolism and that, notwithstanding dogmatic assertions, every given dietary must be based upon a very imperfect knowledge of the intricate digestive processes, we should be chary of basing our practice on any special dietary. Moreover, we must be still more chary of drawing conclusions from our own personal experience. Repeatedly patients are told to avoid this article of diet or that, and the only ground for the objection is that the article disagrees with the physician. It is very curious how many people imagine their own digestive organs to be the standard of perfection.

In prescribing a diet we must be guided by common-sense and consciousness of our own limitations. In forbidding articles of food we may be producing effects other than those we imagine. Thus, when physicians fancy they can stop senile changes by eliminating chalk or common salt from the food of their patient, they must seriously consider not only the effect and the very doubtful result of such deprivation, but the effect their deprivations may have on the patient's mind. Thus, to carry out the instructions to have a salt-free diet, the food for the whole family may have to be rendered unpalatable, for many dishes cooked without salt lose their savour. Moreover, the patient is made conscious at every meal of his heart trouble, and if he travels he may have to take food of which salt is an ingredient, and he then becomes morbidly anxious as to the result. Of course it is foolish for the patient to have taken his instructions so literally, but the physician can seldom imagine the effect of his remarks on a mind made highly nervous because of some cardiac trouble. I have repeatedly seen patients and their friends made absolutely miserable on account of uncalled-for restrictions.

In cases of heart failure a great deal of harm can be done by injudicious feeding. It must be kept in mind that in cases of extreme heart failure and in febrile cases the digestive functions are themselves greatly weakened, and that to pour food into a weakened stomach is not only to add to the discomfort of the patient, but may produce flatulent distension of the stomach and bowels, which presses on the diaphragm and so embarrasses the heart and respiration. The manifest weakness of the patient is often taken as an indication for more food to restore the strength, and satisfaction is felt so long as fluid is seen to disappear into the patient's interior. It is very curious how very prevalent the custom is, when the stomach is weak, to give it more work to do. The food is prepared in such a manner that the assistance of the mouth is dispensed with, and more work is thrown upon the stomach. Bread and milk, a favourite food, is prepared so that no mastication is needed, and the stomach is burdened with the duty of getting rid of the load. The great importance of oral digestion is not sufficiently appreciated. Not only does the process of mastication in several subtle ways stimulate the digestive glands of other organs, but the juices from the mouth are so mixed with the food that they not only assist digestion but prevent the flatulence which is so often such a troublesome feature in the weakened digestion of heart failure.

In cases of extreme heart failure, with dropsy, the food should be very limited in quantity—as a rule, small quantities of milk given at frequent intervals, in extreme cases not more than 1 pint a day. The patient should be encouraged to take a small portion of biscuit, or a dainty sandwich with fresh potted meat, chewed very thoroughly. The mouthfuls should be small, especially when there is laboured breathing. In febrile cases, or when the mouth tends to become dirty, it should be washed and sponged out, and immediately afterwards a small solid piece of food should be given to chew.

With less severe cases the food should be more varied, but it should never be forced on the patient. The quantity he can chew is often a very good guide, because if he cannot be tempted to chew much it is manifest that his digestive organs are at fault, and it is a very bad practice in such cases to pour in beef-tea and other easily eliminated fluids. The guiding principle should be food, tempting, needing mastication, with little fluid, and that chiefly milk, given in small quantity and at fairly frequent intervals, the intervals depending on the quantity able to be taken. The kind of food should be that which the patient likes, so long as it does not disagree with him. Food which causes discomfort or distaste should not be forced. The doctor must be on his guard not to prescribe a dietary suitable to himself, but must bear in mind that what disagrees with him may agree with his patient. In selecting a dietary the resources of an intelligent housewife will often be found to be of much service.

Individuals with heart trouble, but able to get about, should lead a life of abstemiousness, avoiding all excesses. The meals should be small in quantity and of such frequency that all faintness is avoided. It often happens that patients become faint in the night or early in the morning, as they have not broken their fast since the evening meal. A dry biscuit and a small cup of milk at bedtime or in the early morning will often prevent the occurrence of disagreeable sensations.

Exercises.—It may be laid down as a general law that every organ in the body is benefited by the exercise of its functions. The benefit does not accrue merely by the exercise at a low level, but by periods of increased effort followed by periods of comparative rest. This is well seen in all muscular organs, where, in the nature of things, effort is intermittent. Whilst most muscular organs obtain periods of absolute rest, no such possibility can pertain to the heart's action; it has to be content with periods of comparative rest. Nevertheless it follows the law that periods of increased work are beneficial to its well-being. The beneficial effect arises not only from the exercise of its inherent functions but also from the fact that the more energetic action causes the whole organ to be flushed by a larger supply of blood. There is no method nor drug so potent as exercise for rapidly and thoroughly producing a reaction on the heart. This reaction when carried to excess may do harm, but when judiciously employed it is an excellent and extremely valuable help in treatment.

Considering that heart failure is induced by a disproportion between the work the heart has to do and the period of rest, and that therefore a principle in treatment is to give the heart more rest, it seems at first sight paradoxical that exercise should be an agent in restoring the heart's strength. If, however, we bear in mind that there are limits which may be transgressed, and that there are conditions when it is not wise to exercise, just as there are conditions which benefit by exercise, we may be able to determine which cases need or do not need this method of treatment. The conditions which contra-indicate exercise in treatment are acute affections of the heart, and where heart failure is progressive or so extreme that the rest force is being exhausted. All other conditions benefit by exercise judiciously employed, and no abnormal sign should be taken to forbid exercise unless it is accompanied by progressive exhaustion.

The manner of using this really potent therapeutical agent depends on the nature of the case. It is obvious that the same amount and the same form is not applicable to all cases, nor is there any necessity for the many elaborate methods which have been evolved, for none of them possesses any specific virtue, notwithstanding the assurance of their inventors. There is no harm likely to arise from their use, but the belief that only certain methods are efficacious tends to limit the employment of exercises as a general method of treatment.

When the patients can go out their exercises should be in the open-air, even though it is limited to certain gymnastic movements. If they can walk quietly that in itself may be sufficient, and if the walk be taken systematically a great amount of reserve force may gradually be acquired. As a rule, people benefit more by exercise when it has an object beyond medical needs, hence the added interest of a game or the study of objects of interest, as architecture, botany, etc., will add materially to the efficiency of the exercise. The particular taste of each patient has therefore to be studied and the form of exercise prescribed that is likely to combine therapeutic with personal interest.

When patients are confined to the house or to bed moderate exercise of the muscles proves useful so long as it does not embarrass the heart. To this end the various movements and gymnastics may be of use.

In the great majority of cases of serious heart failure even, after recovery has set in, the judicious employment of muscular exertion is beneficial. It may be a matter of difficulty to determine whether more serious cases are fit for exertion, and if so to what extent. There is a very simple rule I have been accustomed to follow for years with the greatest satisfaction: Let the patient employ what form of muscular exercise he can best do without cardiac discomfort. By discomfort I mean the various signs which are given by the heart when its work force is exhausted—breathlessness, palpitation, sense of exhaustion, pain. No fixed amount of exercise should be made, for an amount of effort that exhausts a patient one day may be undertaken with ease the following day. If the rule is followed that the amount of effort bed etermined by the ease with which it is accomplished, no danger will arise from over-exertion, while opportunity will be afforded for the heart to secure its full measure of strength. Discomfort may be experienced first in the muscles exercised when some particular group of muscles is more particularly employed, as certain thigh muscles in climbing, and certain arm muscles in playing golf, indications more of want of training of these muscles than of heart exhaustion. This form of discomfort need not prevent further exercise.

Massage.—To patients who are perforce confined to bed, but for whom absolute rest is not imperative, as in convalescence from febrile affections of the heart, the well-known good effects of massage are often helpful. It is particularly useful for patients who may be expected to regain sufficient strength to be able to resume an active life, as in the convalescence from febrile affections, after the more urgent symptoms have disappeared in all forms of extreme heart failure, in patients with angina pectoris when the heart exhaustion has for the time gone so far as to necessitate complete rest. In dropsical cases the gentle but firm massage of the legs may prevent the dropsy reaching an extreme degree, and in some cases it accelerates its disappearance.

It is not necessary that a skilled person should apply the massage, for that would exclude its use among the majority of sufferers, the gentle but firm pressure intermittently applied to the muscle, systematically undertaken, is usually quite sufficient.

Baths and Spa Treatment.—A very powerful influence can be exercised on the circulation by immersion of the body in water. This may act in several ways, mainly depending on the temperature. Great therapeutic efficacy is claimed for certain waters, but it is very doubtful if any ingredients in these waters have any effect upon the heart beyond their effect in stimulating the skin. My personal experience has been limited to visiting a few spas and to observing the results in patients who have returned from the various spas, and I have seen nothing of their good effects to lead me to place hydrotherapy very high as a means of treating affections of the heart. No doubt some good results from the whole *régime* pursued at the different spas, including baths. I have seen some very good results from patients who have bathed in the open sea. When I have had patients who were fond of sea bathing I have allowed them to indulge in it, warning them to refrain if it brought on any sense of discomfort. In many cases the result has been extremely satisfactory, the whole system of the patients has been braced up, and they have returned from their holiday greatly benefited.

Sea bathing has after all only a limited sphere of usefulness and many patients obtain great benefits from visiting spas, and the supporters of each claim for its waters some special virtue. In order to assess the value of the claims it is well to bear in mind by what process benefit is obtained at the various spas. The vast majority of patients go there as much for a holiday as for treatment, and when a patient is sent there it is often because the individual, in addition to his complaint, has been busy with his affairs, and his heart complaint has been thereby aggravated ; or a patient is convalescent and a change of air, scene, and mode of life is often found beneficial. As the various spas cater for the more enjoyable side of existence, they attract large numbers of invalids who naturally desire the reputed benefits of the waters and drink them enthusiastically, or if they cannot drink them, at the least bathe in them. It will thus be seen that the benefits gained at such places arise from a variety of sources, and it is but in accordance with human nature to attribute what benefit has accrued to the factors that most appeal to the imagination, such as gaseous waters from the bowels of the earth. Every practitioner of experience will agree with me that a large proportion of heart cases return from their holiday greatly improved, and this improvement is not limited to those who went to some particular spa, but includes all sorts of factors, spas, seaside and mountain resorts, sailing on sea or lake. It is evident that results thus obtained cannot be due to the peculiar constituents of the waters of any single place.

Venesection.—In a number of cases the abstraction of blood from the patient affords very considerable relief. Unfortunately the relief is only temporary and in extreme cases only delays the end. Although I have practised venesection in a great variety of cases, I cannot say I have seen it do any lasting good. The indications for its use that have been my guide have been distress in breathing, on account of great distension of the right heart. In cases of mitral disease this has generally been recognised by the increase of the heart's dulness to the right. In cases of high blood pressure (cardio-sclerosis) it has sometimes been difficult to detect much enlargement of the right heart, and the tense filling of the veins of the arm has been the indication. I have always bled at the usual place, at the bend of the elbow, and abstracted from 20 to 30 oz. of blood. The immediate relief given to the patient is often very striking. In cases where there are repeated attacks of heart failure, more particularly in cases of auricular fibrillation, venesection is sometimes employed and good results are obtained.

DRUGS.

In entering upon this part of the subject of treatment of diseases of the heart we are met by such a number of drugs for which such potent effects are claimed that it is not possible for one individual to appraise the value of all of them. When, however, the searcher after truth endeavours to find out on what grounds a great number of these remedies have acquired their reputation, he finds such an absence of evidence of value that many of them merit little or no consideration. In taking this line it might be said that evidence is being wilfully ignored, but we must consider what is evidence. In regard to the heart we get such unmistakable evidence of the effect of drugs that the proof of any active drug is easy to obtain. The manner in which a drug can modify the action of the heart, the rhythm of the heart, and the blood pressure can be so readily registered that it is easy to demonstrate the specific effect of any drug upon the heart or blood-vessels. Morever, other phenomena, such as the response to exertion, alteration in the size of the heart, generally go hand in hand with the more demonstrable effects. Nowadays the statement of any authority, however eminent, should count for very little unless he is prepared to give more definite proofs for the faith that is within him than his mere assertion. We need only point to the widely prevalent idea that strychnine is an active and valuable cardiac drug to appreciate the futile manner by which drugs may acquire a reputation. There is not a single observation, clinical or experimental, of the slightest value to show that strychnine in medicinal doses has any effect upon the heart or blood-vessels. The whole evidence is based upon the conclusion drawn from extremely doubtful experiments on the frog's heart and upon the fact that some patients have fancied they were better after it. I have already dealt with this kind of evidence when speaking of suggestion. These methods of estimating the value of drugs are widely employed and lead to such inaccurate and unfortunate results that it seemed to me, with the great advance that has been made in recent years in our diagnostic methods and our more exact knowledge of the more common cardiac phenomena, that it was desirable these advances should be used for the study of drugs that affect the heart.

For many years, while engaged in general practice, I had been carrying out an investigation on these lines, and had obtained many striking and instructive results. The subject is a big one and it demanded more careful methods than one could apply in general practice, so that when I was given the charge of the cardiac wards at the Mount Vernon Hospital, Hampstead, Professor Cushny associated himself with me in carrying out a definite series of observations on all sorts of cardiac drugs. As we desired, above all things, to make our observations of real practical value to the general practitioner, we employed the remedies in the form most commonly used in general practice. We elected to begin with the drugs administered by the mouth, as it is manifestly absurd to expect a busy practitioner to give his remedies by hypodermic or intravenous injections. The following description of the effects of remedies will therefore be based upon the results obtained in this investigation.

Needless to say, many negative results are not included here.

When patients come first under our care we put them to bed and allow them a limited liberty according to the degree of heart failure. Any incidental trouble from which they might suffer, as flatulence, constipation, sleeplessness, was remedied. Careful observation was made on their powers of response to effort, estimating the work force of the heart by noting how they performed some standard exertion. Accurate records were made as to the heart's rate, rhythm and size, the movements in the arteries and jugular veins, condition of the lungs and respiration, the blood pressure, the state of the liver and kidneys, the extent of dropsy and other evidences of heart failure. The daily progress of the case as measured by these phenomena was carefully recorded. When the condition was urgent drugs were given at once, but where there was no urgency the effect of rest alone was allowed to act, and so long as improvement continued no drug was given. When no further progress was made we placed the patient upon such drugs as seemed likely to improve his condition, and that drug was pushed until some physiological effect was shown. The drug was then withheld or diminished according as the patient's condition seemed to warrant. If the result was not satisfactory the patient was allowed to come out of the influence of the drug, another remedy substituted, and the same process repeated. Professor Cushny took samples of the different drugs used and submitted them to a physiological assay, while patients showing any doubtful or obscure reaction were examined by Dr. Lewis by means of the electro-cardiograph. It will be understood that this method of observation is very laborious and time-robbing, and can only be undertaken by those who are familiar with the use of the various mechanical methods employed in the clinical study of the heart and capable of interpreting accurately the results. These are still capable of improvement, but will afford essential aids in this much needed line of research.

Digitalis.—The most valuable cardiac drugs we possess belong to the series which includes digitalis, strophanthus and squills, these drugs having a remarkable similarity in their action upon the heart. Of these digitalis is the most useful, and it will be found that if digitalis fails to act the others will be of little value. Unfortunately, in some people accompanying the cardiac action, other effects are produced which are so disagreeable as to prevent the continued use of the drug. Under these circumstances the same cardiac reaction can be obtained sometimes by strophanthus or squills, with less disagreeable effects on other organs.

One peculiar feature about the action of digitalis is the difference in its effects on different individuals. In some there is quickly developed an intolerance of the drug, on account of nausea, vomiting, severe headache or diarrhœa. In others it acts speedily upon the heart and produces a different result in different people. In many the effects on the digestive and circulatory system are coincident, the first sign of nausea being accompanied by a marked reaction upon the heart. In others large doses can be taken for indefinite periods with little or no effect upon the patient, the preparation employed being exactly identical with that which produced a reaction in others. This inconstant reaction is a common experience, and has usually been attributed to variations in the potency of the preparation used or in the capricious nature of the drug. As an outcome of the careful observations of these varied reactions, I have no hesitation in saying that the variability is not due to the drug, but rather to the differences in the susceptibility of individuals or to the nature of the lesion by which they are affected.

Before prescribing such a drug as digitalis we should have a clear idea of our object. In a great many individuals there may be symptoms referable to the heart, such as a feeling of weakness or palpitation, and some abnormal sign may be found in the heart, such as a murmur or irregularity, and therefore digitalis is supposed to be indicated. Small doses (1 to 5 min. of the tincture) are prescribed, and any good results that may follow are attributed to the small doses of digitalis. While I am not prepared to say that the digitalis has not been of some use in such cases, I can however confidently assert that there is never shown any evidence characteristic of the action of the drug with small doses until a considerable quantity of the drug has accumulated in the system. Even in severe cases of heart failure, where rest is enjoined, the good effect of the small doses which have been given has been in all probability obtained by the rest and the accompanying care to protect the heart from excitement. This conclusion has been forced upon me by the careful observations of the effect of rest and small doses, and it needs to be commented upon for the reason that faith in small doses is so common in the profession and much injury results from not pushing digitalis in really serious cases.

When there are undoubted signs of heart failure, such as breathlessness on exertion, dropsy, or a rapid action of the heart, digitalis, when indicated, should be given in fair doses and pushed until some physiological reaction is produced. This physiological reaction varies in different people, and in some its nature depends on the character of the heart lesion. The most common symptom of a sufficient dose is nausea or even vomiting. In a great many cases, as soon as this appears, the heart will be found affected, usually by becoming slow in its rate, continually or at intervals, while at the same time there may be dropping out of ventricular systoles (heart block), or the occurrence of extra systoles. When this stage is reached the drug should be stopped for twenty-four hours or till the nausea has passed off. It often happens that as soon as the nausea has passed off the patient feels remarkably well and is able to exert himself with less distress. Our aim is to keep the heart at the rate at which he feels best. This is achieved by giving the patient half the dose at first, watching to see if the pulse rate alters, and increasing or diminishing the doses according as the pulse rate increases or diminishes. After a time the patient can tell by his own sensations when he has had enough and when he needs more, and I have found these sensations invariably an excellent guide, and in many cases can leave the future administration of the drug to the patient. This is particularly the case when the patient suffers from old rheumatic affections of the heart or where auricular fibrillation has occurred. I have watched patients who managed themselves with digitalis over long periods, ten years and more, and have never seen anything but good result, the tendency to nausea being a signal to stop and acting as a prevention against an overdose.

In watching cases going under the influence of digitalis for the first time, and when the patient is going about or able to get out of bed, I have found the first effects of digitalis can be detected by observing the rate and rhythm of the heart after exertion. A patient makes some effort, such as walking round the room or up one or two flights of stairs, according to his strength and condition. After he lies down the rate and rhythm of the heart is graphically recorded or the heart is auscultated. After the rapid action in consequence of the exertion has subsided, if the heart is under the influence of digitalis, it will be found to become slower than it was before exertion was made. The slowing occurs very often periodically, the slow periods separated from each other by ten to twenty beats. During the periodic slowing extra systoles are apt to occur, and in certain cases heart block. This reaction only occurs when the normal rhythm is present, that is, when the normal auricular systole is followed by a normal ventricular systole. In auricular fibrillation there is only a marked slowing of the pulse, sometimes with coupled beats and sometimes with long pauses.

In discussing the physiological action of digitalis, too much reliance has been placed hitherto upon the results of experiment, the supposition being that similar effects would be shown on the human heart; while little or no consideration has been given to the fact that the human heart to which digitalis has been applied is the seat of a disease process which may profoundly modify the heart's action and in consequence produce results which cannot be obtained by experiment. It is commonly asserted, for instance, that as digitalis acts upon the muscular wall of the arteries, it is useful to raise blood pressure and is contra-indicated in cases of high blood pressure. In all our observations made at the Mount Vernon Hospital, as well as those made for many years in private practice, we have never found a single instance where the blood pressure was noticeably raised, but a great number in which it was lowered.

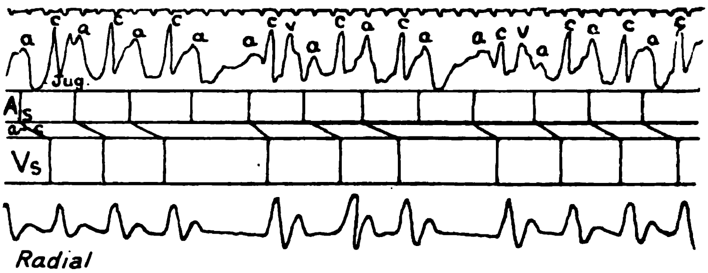


FIG. 1.—Simultaneous tracings of the jugular and radial pulses, showing intermission of the radial pulse. The intercalated diagram represents the auricular systoles (A_s) by the downstrokes in the upper division and the ventricular systoles (V_s) by the downstrokes in the lower division, while the passage of the stimulus from auricle to ventricle is represented by the slanting line in the middle division (*a–c*). It will be seen that during the pause in the radial, the stimulus failed to pass from auricle to ventricle, the passage being "blocked." This reaction occurred after 19 granules of digitalin had been taken.

A great deal of good results from the slowing of the heart's action. I have already referred to the fact that a pause of extreme brevity in the diastole of the heart is enough to increase greatly the strength of the following systole. This slowing by digitalis probably acts through stimulation of the vagus, and all the chambers of the heart take part in the slowing. In addition to this slowing of the heart, as a whole, a still further slowing of the ventricle is sometimes found, due to the fact that the stimulus fails to reach the ventricle after the auricle has contracted (partial heart block). In nearly all the cases in which this occurs there will be found in the jugular tracing an increase in the interval between th wave due to the auricle and the wave due to the carotid (a wide a-c interval, *see* Fig. 1). It can with fair certainty be assumed that this is evidence of some damage to the auriculo-ventricular bundle and that this is one of the instances where the reaction due to digitalis is dependent on the nature of the lesion in the heart.

I have always found when digitalis has slowed the heart in this manner, either with a slowing of the whole heart or with the occurrence of partial heart block, that the patient was much better, could breathe more easily and do more exertion with comfort. Digitalis should not be pushed beyond this stage. I generally stop it for a day or two and then resume with smaller doses of sufficient strength to maintain the slow action. I am also guided by the patient's sensations of improvement.

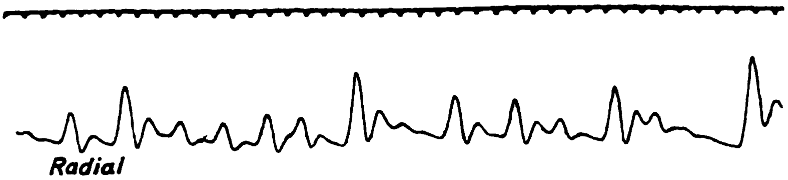


FIG. 2.—Tracing of the radial pulse showing the irregularity characteristic of auricular fibrillation during a period of severe heart failure. Rate 115.

The peculiar action of digitalis on the auriculo-ventricular bundle, depressing in it the function of conductivity, and producing a partial heart block, is partly responsible for the great reputation of the drug in these cases, where it has been of such unmistakable benefit in treatment. Where digitalis has been given to patients with extreme heart failure, when the patient was evidently in peril of his life and where in a few days a great and striking alteration has occurred, all my cases have been those whom I have hitherto described as cases of "nodal rhythm," but which we now recognise as cases of auricular fibrillation. In searching the records in literature for the evidence of the good effects of digitalis, I feel fairly certain that it is in patients with auricular fibrillation, particularly when it is subsequent to

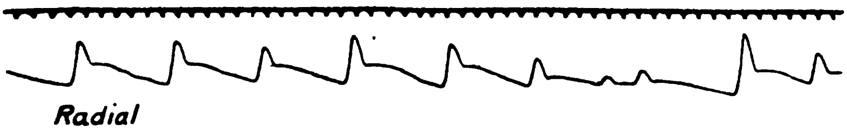


FIG. 3.—From the same patient as gave Fig. 2 after ʒiij of tincture digitalis. The patient's condition had greatly improved. Rate 55.

rheumatic fever, that the extraordinary good results have been obtained. If we read carefully the records given by Withering in the first valuable account of digitalis in 1785,—he only used it as a diuretic, yet he noted its good effects in heart cases—we are forced to the conclusion that several of his successful cases had undoubtedly auricular fibrillation. I have repeatedly seen such patients in the direst distress greatly relieved and freed from danger in the course of a few days. It is seldom that one can really claim to have saved a patient from imminent peril by the use of drugs, but I think I am justified in saying that this has frequently been done by the administration of digitalis. We may find a patient suffering from severe dyspnœa, unable to lie down, the pulse very rapid and irregular, and the liver pulsating 3 or 4 inches below the edges of the ribs. By giving him sufficient digitalis, in the course of a few days the heart's rate is markedly diminished, the distressed breathing is gone, the liver is scarcely perceptible below the ribs,

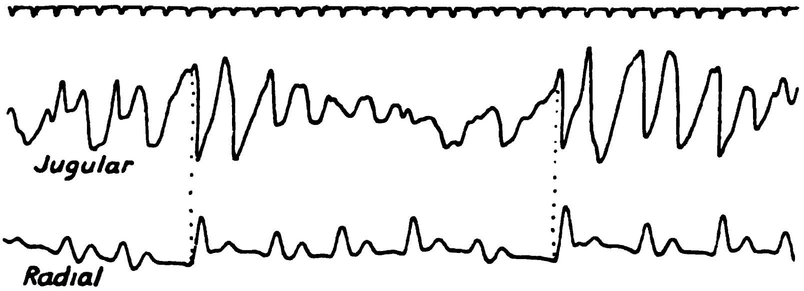


FIG. 4.—Simultaneous tracings of the radial and jugular pulses in a case of mitral stenosis with auricular fibrillation during a period of severe heart failure. Note the characteristic irregularity of the radial pulse.

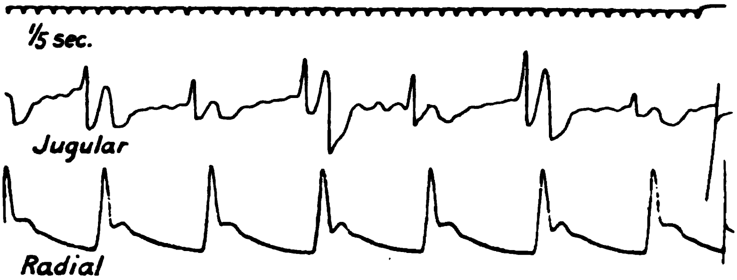


FIG. 5.—From the same patient as gave Fig. 4, when ʒvj of tincture digitalis had been taken. The patient's condition had greatly improved. Rate of pulse 50.

the patient is able to lie flat, to sleep, and to walk about quietly in comfort.

I describe later the characteristic symptoms by which the condition of auricular fibrillation can be recognised. The mode of action of digitalis seems to be by slowing of the ventricular rate. As records of the jugular pulse and observations by means of the electrocardiograph show the auricle is still in fibrillation, it is not by the action of digitalis on the auricular muscle that the slowing is produced. If we assume that in fibrillation of the auricle that many of the numerous stimuli arising in the auricle are sent through the auriculo-ventricular bundle to the ventricle as fast as the bundle or the ventricle can receive them, then by depressing the conductivity of the bundle or the excitability of the ventricle fewer stimuli will reach the ventricle and this will consequently have more time for rest and for restoration of its strength. In view of the fact that digitalis can be shown to depress readily in some cases the conducting function of the bundle, it is probable that it is by its action in this manner that it does so much good in auricular fibrillation, so that, notwithstanding the persistent fibrillary action of the auricle, the ventricle is protected from this irritability. This effect is produced probably through vagus stimulation, though it is possible that there may be a direct effect upon the fibres of the bundle or of the ventricle dulling their susceptibility.

In addition to the slowing of the ventricular rate, other effects of the digitalis may aid its beneficial effect, such as its action upon the contractile force or upon the tonicity of the heart muscle. In regard to the latter action it is certainly in cases of dilatation of the heart that the best results are seen, though I have been able in relatively few cases to make out much diminution in the size of the heart when there has been otherwise a marked reaction.

When dropsy is present, coincident with the improvement in the heart, the flow of urine often becomes markedly increased. In cases without dropsy very little change has been noted in the quantity of urine passed, even when the heart has become much slower and the patient's condition has been greatly improved.

Preparations of Digitalis and Method of Administration.—As a result of my experience I prefer to push the digitalis until some physiological reaction occurs, as nausea, diarrhœa, slowing of the heart, etc. I am confident if an outlook is kept for such signs that there need be no fear of poisoning or of any deleterious effect. The dose, therefore, in any given case partly depends on the nature of the case. In giving the tincture to an adult doses of 15 to 20 min. thrice daily usually produces its effect in from four to seven days.

If the distress of breathing is great and the pulse rapid double the quantity may be safely administered, and the physiological effect looked for in twenty-four hours to forty-eight hours.

The form of preparation I have used as a standard is the tincture, which I have never yet found to fail me. If it can be got of a guaranteed strength well and good, but I soon find out for myself whether it is active. I use the tincture because it is handiest and the most reasonable in price, a very important consideration to the general practitioner in practice amongst the working classes. A more elegant preparation may be used, and I have made a large number of observations with digitalin (Nativelle's granules). Each of these granules I have found to have had the same effect as about 15 min. of the tincture. Many patients themselves buy the leaves and make an infusion of variable strength, and they get to know the physiological effect and treat themselves. One man whom I have had under observation for ten years with auricular fibrillation uses as a standard the degree of swelling in his legs, his test being that when he cannot comfortably lace up his boots it is a sign to take his home-made infusion of digitalis.

So far I have seen no special virtue in the various extractives got from digitalis, and I see no ground for according.them priority over such a preparation as the tincture, which includes all the different glucosides.

In persistent dropsy due to heart failure greater benefit may be obtained when the digitalis is combined with mercury and squills (as, for instance, mercurial pill, 2 gr.; powdered digitalis leaves, ½ gr.; squills, 1 gr.). This combination is often useful when digitalis by itself is without effect. One patient received much benefit from this preparation, but she was so readily salivated by the mercury that the medicine could not be used a sufficient length of time. A number of other preparations of digitalis and strophanthus were tried without effect. At last the patient took the pills with her food, and for some reason she was not again salivated and was able to keep her dropsy in check.

It is possible that a more speedy effect may be attained by hypodermic injections of digitalis, but in the few instances I have seen it used it showed no appreciable effect. Unfortunately it is used too often when the patients are dying from some grave affection, as pneumonia, as a last resort, probably more for the purpose of doing something than with expectations of great benefit. I have never seen much good follow the administration of digitalis in acute febrile states. The factors exciting the heart (high temperature, toxins, or the invasion of the heart by specific organisms) exert an influence over the heart which the digitalis cannot combat. I think it desirable to mention this, as it is a waste of time and opportunity to apply remedies which are of no avail in urgent cases, while by recognising their uselessness we may search for more helpful measures.

The recommendation of digitalis is usually accompanied by warnings as to dangers which may result from its use. It would be of great advantage if writers would state clearly what the danger is of which they are afraid. So long as vague statements are made that such a drug should be used cautiously or sudden death may result, the reader is oppressed by some fear which is all the greater because of the indefinite nature of the warning. If writers would even give the experience which led them to make use of their warning, the value of their experience might be ascertained. But when they limit their injunction to obscure hints, they play upon he characteristic weakness of human nature, for the mysterious nd the unknown inevitably provoke fear, whereas the bare citation f the writer's experience would very likely rob the whole statement f the mysterious and therefore of the fearsome. I state this ecause I have failed to recognise those cases where there is danger the use of digitalis. I can imagine that danger might arise if e drug was pushed beyond the limits indicated by the first signs its physiological action, and I can only say that in over thirty ars' familiar use of the drug I have never yet seen any evil result m its use when given in the manner I have indicated. I have n great distress arise from overdosing, when others have given and neglected the physiological signs of sufficiency. I have wn a patient with auricular fibrillation die suddenly when taking italis, but I have known others die equally suddenly who were taking digitalis. When we reflect that digitalis is given to rly all individuals who are supposed to be suffering from a heart tion and that patients do die suddenly from heart affections, not unlikely that patients with heart affections and who are g digitalis may die suddenly, but it is illogical to state that igitalis is therefore of necessity the cause of sudden death.

the recommendation of the use of the drug I have followed the ts of my own experience and that of some other observers. It t right to state that there are authorities who recommend lis in much smaller doses even in grave cases, and some find nce of its good effects in the course of a few minutes, others course of a few hours. Hare recommends, with rest, not than five drops of the tincture three times a day. He thinks oses are only justified when the heart is in an exceedingly feeble state and the patient's condition is critical, so that immediate stimulation is necessary.

Strophanthus.—As in the case of digitalis, there seems to be a discrepancy between the experimental results and the therapeutic when applied to human beings.

"Strophanthus acts as a stimulant to the heart muscle and its ganglia, but does not slow the pulse by its action on the vagus as does digitalis" (Hare).

As an outcome of my own experience in private practice and researches at Mount Vernon Hospital, no distinction can be made between the reaction of these drugs. Patients whose hearts are affected by digitalis in a peculiar manner are affected in a like manner by strophanthus. The slowing which is accepted to be due to vagus stimulation is produced by both, so that what I have written above of digitalis applies to strophanthus. In some cases there was not such a marked effect upon the digestive tract, although in other cases the reaction was just as severe. The headache, too, was found to arise from both drugs in the same individual.

Taking the B.P. tincture as our standard drug, we found in most cases about twice as much tincture of strophanthus was required to produce the same effect as the digitalis. When Professor Cushny tested physiologically the two tinctures, he found in the exposed heart of the frog the tincture of strophanthus was thirty times stronger than the digitalis. From this we can infer that the absorption of the tincture of strophanthus from the digestive tract is in some way interfered with.

The difference in the relative activities of the two drugs was impressed upon me several years ago by their effect upon a young man whom I saw in consultation. His heart was affected by a rheumatic lesion; he had mitral stenosis and auricular fibrillation. For years he had been accustomed to keep his heart fit by taking digitalis. When I asked him if he had tried strophanthus he replied that he had, but that it took twice as long to get so good a result.

In somewhat urgent cases of old rheumatic hearts, where there was auricular fibrillation, I have seen remarkably good results follow big doses of the tincture of strophanthus, as much as 3 drachms in one day. Within thirty-six hours sickness and nausea were experienced, but at the same time the heart's action had become much slower and the patient's general condition improved.

Strophanthus has been used intravenously by several observers, and in some of the recorded cases marked results were obtained. The most instructive paper on this subject is one by H. C. Bailey, in which a number of cases are detailed with graphic records.

From the study of these records we can recognise the nature of the heart affection, and we find that the best marked reactions were obtained in cases of rheumatic hearts with auricular fibrillation. From this we can conclude that the reaction in these cases are practically the same as might have been expected from the full doses of the tincture of digitalis and of strophanthus. The reaction is certainly much more rapid, and we can understand that in exceptional cases it might be necessary to obtain this rapid reaction, but such cases must be exceptional, for I do not recollect any case where there was such urgency as could not be met by full doses by the mouth. Still, it is well to know that we can have the prompt effect of strophanthus in this manner.

Bailey used doses of ½ milligramme of crystallised strophanthus in his intravenous injection, and got evidence of its effect upon the heart in one hour's time. The effect of such a dose passed off in twenty-four hours' time.

Bachman records a case of complete heart block, where the intravenous injection of strophanthus was followed by a quickening of the ventricular rate from thirty to thirty-five beats per minute. This suggests the possibility of its employment in those cases of heart block with great infrequency of the pulse rate, leading to attacks of loss of consciousness and convulsions (Adams-Stokes' syndrome).

Squills.—In a few cases where digitalis and strophanthus were not well borne because of trouble with the digestion or headaches, we have obtained very satisfactory results with the tincture of squills, carefully pushed. Its physiological effect is identical with that of the other two drugs, and the reaction can be obtained in about the same time and in the same doses as with the tincture of digitalis.

The Nitrites.—The principal effect of the nitrites upon the blood-vessels is to cause dilatation of the arteries and veins. It is now accepted that the cause of the dilatation is by the depression of the nerves and muscles of the vessel walls. This effect is accompanied by an acceleration of the heart rate, and a great fall in the arterial pressure.

When for any reason a sudden effect is wanted upon the heart the nitrites are the most potent of drugs for the purpose. A few drops 3 to 10 min.) of nitrite of amyl inhaled produces its effects in a ew seconds. The face becomes flushed and the patient becomes onscious of throbbing in the head. If the drug is continued the atient becomes faint and giddy and is forced to lie down. It hould never be pushed beyond this stage. In a few moments the effect has passed off and the blood pressure, which has undergone a sudden fall, gradually rises, and may even become higher than it was before the inhalation.

Other nitrites, as nitro-glycerine (dose $\frac{1}{100}$ gr. in tablets or in alcoholic solution), erythrol tetranitrate (dose 1 gr. in pills), sodium nitrite (1 to 2 gr. in pills or solution), act in the same way as amyl nitrite, but more slowly, but the effect remains longer.

Spiritus ætheris nitrosi (sweet spirit of nitre) is a very popular remedy. It contains traces of ethyl nitrite and is often prescribed in doses of 30 to 60 min. for its supposed effects in relaxing the vessels. As it is usually prescribed in mixtures with water the nitrite which it contains rapidly evaporates and the resultant effect is due to the ether and alcohol.

The best therapeutic effects of nitrites are obtained in cases requiring rapid action, as in angina pectoris. Some of the slower acting nitrites are recommended to reduce high blood pressure, but I have had no satisfactory results from them when used for this purpose, nor does it seem a reasonable procedure to use them when the increased blood pressure may be due to some irritating substance circulating in the blood (as in kidney disease).

Iodide of Potassium.—The iodides, particularly the iodide of potassium, have obtained a reputation as drugs of great therapeutic value in cardio-vascular disease. The undoubted good results seen in syphilitic affections have led to its employment in such conditions as aneurysm, and Balfour and Bramwell have particularly extolled the virtues of iodide of potassium in this affection. It is frequently used in all sorts of senile changes in the heart and blood-vessels, and remarkable virtues have been attributed to its action. It is difficult to understand, however, how it acts. It used to be held that it lowered the blood pressure, but careful observations show that it has little effect on the blood pressure. Many suggestions have been made as to its action on the walls of the blood-vessels, but this view is purely speculative. The fact that some observers say that it is necessary to give large doses (20 to 30 gr. three or four times a day), while others claim equally good results from doses of 5 to 10 gr., seems to indicate that the resultant benefit may be due to the alteration in the patient's habits which accompany the use of the drug, as rest, change of diet, etc.

Sedatives.—Little benefit is likely to arise from treatment, so long as a patient is worried and sleepless. I have already referred to the importance of rest, and it is often necessary to seek the aid of drugs to obtain rest and sleep and freedom from worry and other excitations, and sedative drugs used with discrimination are of the greatest use.

The bromides are the most useful drugs in this respect. In all cases of mild degrees of heart failure, where the patient is able to get about, but where he is worried, sleepless, irritable or apprehensive, the bromides are extremely useful and of far more value than other cardiac drugs. I have for years employed the bromide of ammonium, being under the impression that the patients were not so depressed from its use as from the bromide of potassium, but this may be a false impression, as I have not compared the effects with sufficient precision. The drug should be pushed until a slight lassitude is induced, or even till the patient becomes torpid, particularly in severe cases of angina pectoris. The doses employed are 20 gr. two to four times a day, according to the severity of the case.

For sleeplessness the milder hypnotics may first be tried, as the bromides, antifebrin, veronal or sulphonal, but if these fail, resort must be had to chloral or opium. In great restlessness due to dyspnœa, Cheyne-Stokes' respiration, cardiac asthma, one of these drugs should be carefully pushed until the desired effect is obtained. Five to ten grains of chloral every two hours, or ¼ gr. of morphia ($\frac{1}{8}$ gr. hypodermically), repeated every two hours, will often suffice, but if these fail large doses must be given. When there is œdema of the lungs or bronchitis the opiates should be avoided, as they tend to check the free expulsion of the phlegm, and danger may arise from this cause.

Oxygen.—The administration of oxygen in affections of the heart has been followed for many years, but the results on the whole are disappointing, though there is a limited field where it seems to be of use. It is difficult, however, to describe the condi-
ions that call for its use, and I have given it in a great variety of
ases, in some with excellent results, in the majority with no
ppreciable benefit, or only temporary relief. Even in patients
uffering apparently from similar affections, the results have been
ry unequal; for instance, a few patients suffering from cardiac
sthma have been greatly relieved, while others have experienced
benefit. This difference in effect caused me to look more care-
lly into the symptoms present, and I found that those who got
nefit had always evidence of cyanosis.

The conditions in which I have found oxygen of benefit are in
ne cases with Cheyne-Stokes' respiration, cardiac asthma, angina
toris and heart block; sometimes in cases of angina and cardiac
hma the patient has had better nights when the oxygen has been

taken for a quarter of an hour before going to bed. In most cases relief has occurred during the attack of dyspnœa or pain and when the oxygen was taken in cases of heart block, during the attack of unconsciousness.

I have followed Leonard Hill's methods of administration by giving the patient large doses. Hill employs a mask, which encloses the patient's head, and the oxygen is poured into the mask from the cylinder, so that the patient breathes practically pure oxygen. I have used in many cases a lady's hat-box, in which a piece is cut out for the neck, the head enclosed in the box and the lid put on it, and the oxygen given through a hole in the box. The head is then surrounded by an atmosphere of almost pure oxygen. By this method Hill states a far greater amount of oxygen is taken up in the blood. The duration of an administration lasts from ten to twenty minutes.

Aconite.—In medicinal doses aconite is supposed to act upon the heart through vagus stimulation, and a very current impression is that it is a powerful drug in slowing the heart and in weakening its action. The dose when given frequently is stated to be from 2 to 5 min. of the B.P. [U.S.P. 1 to 2½ min.] Tinc. Aconiti preparation. In a series of observations on its action we carefully increased the doses of the tincture in a number of patients till 15 min. [U.S.P. 7½ min.] were taken every two hours for several days. Accurate records were kept of the pulse rate, blood pressure, and the patients' sensations, but no effect was observed. Presuming that the preparation was not a good one, we tried others, so-called standard preparations, and the same absence of result was experienced. We then tried aconitine, beginning with doses of $\frac{1}{600}$ gr., gradually raising the dose to $\frac{1}{200}$ gr. every four hours. After a couple of days the pulse rate was if anything increased, the patients felt a good deal of discomfort, a disagreeable pricking sensation in the throat with a sensation of choking, numbness of the limbs, a good deal of sweating, and towards the end of the observation painful consciousness of the heart's action, which at times would beat violently and rapidly. In cases of auricular fibrillation with rapid heart action, when digitalis produced slowing, no slowing resulted from the aconite.

Atropine.—The principal effects of atropine upon the circulatory system is said to be due to its action in paralysing the cardiac inhibitory terminations.

In practice it has been found to be of use in rare cases of heart block when there has been some difficulty in the passage of the stimulus from auricle to ventricle. When this occurs an increase the difficulty may result in the stoppage of the stimulus passing, d as it is well known that vagal action does produce this delay the conduction of the stimulus, atropine given in such cases y cause removal of the heart block. In a few cases it has en found that during Adams-Stokes' convulsions, the injection of opine has apparently given temporary relief, by increasing the e of the ventricular contraction. My own experience is too ited to permit me to speak of this matter with any authority, but eing that all remedies are as a rule of little help in patients with acks of loss of consciousness due to heart block, this remedy ould be given a fair trial.

It should be given by hypodermic injections in doses of $\frac{1}{100}$ gr. d repeated in half an hour if necessary.

Other Drugs or Remedies.—A great number of agents are ed in cardio-therapy, but it is doubtful if many of them have any al effect on the heart. Some undoubtedly can show evidence of a action, such as alcohol and hot fluids ; their activity in producing dilatation of the arterioles can be employed with benefit when a pid effect is desired, as in attacks of angina pectoris or of faintness prostration. It is scarcely necessary at this time of day to add warning as to the use of alcohol in milder forms of heart failure, d particularly in those with a neurotic tendency. The temporary nefit obtained may lead to a too frequent use with the danger of habit being created.

Other drugs, as caffeine and strychnine, act probably through e nervous system, and by producing some exhilaration prove eful in cases when a temporary exhaustion causes distress. But cannot be too strongly insisted upon that though they are com-only employed in extreme cases of the most diverse kind, for stance, as where there is a rapid heart in pneumonia and where ere is a sluggish ventricle in heart block, their usefulness is of a ry limited kind, and should not be relied upon in cases of real art exhaustion.

SYMPTOMS AS INDICATIONS FOR TREATMENT.

Whilst the principles which, in the preceding sections, have been id down for the treatment of heart failure are applicable to cases ere the heart fails to maintain an efficient circulation, there are great many symptoms which cause distress to the patient, actual ysical discomfort or mental distress, and which may give grave ncern to the physician who does not clearly realise the significance the symptoms. I therefore deal with the more prominent of these symptoms, indicating which need no treatment and giving the result of my own experience of such as call for treatment.

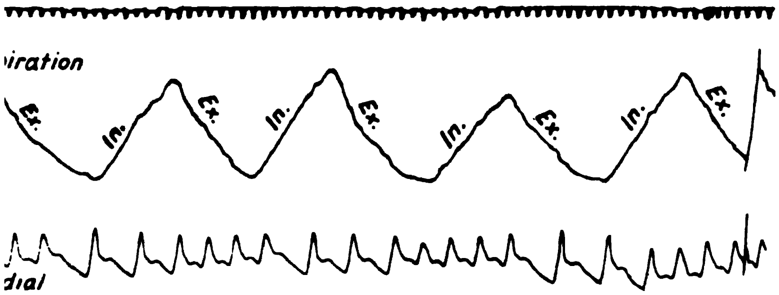
IRREGULAR ACTION OF THE HEART.

The most common form of abnormal sign, or what is taken for abnormal sign, is irregular action of the heart. Up to twenty years ago irregular action of the heart was among the most obscure affairs in the practice of medicine. Writers up to quite recent dates either ignored the symptom, or dealt with it so perfunctorily that if one were to judge from the literature the symptom might be of little consequence and of rare occurrence. In everyday practice the observing physician could not but be struck by the great frequency of irregular action and the dread with which it is viewed by patients and physicians alike. It is no exaggeration to say that the persistent study given to the subject by observers during the last twenty years has not only demonstrated the great frequency of the symptom, but has thrown such a flood of light upon heart irregularities and upon their bearing on the patient's condition that few subjects in clinical medicine are better understood now. Not that the subject is exhausted, for there are many abnormal actions of the heart that are still obscure, but the great majority of cases can be readily recognised. I shall deal here with those that are the most common.

When a large number of cases of irregular action of the heart are studied, three great groups can be separated, which include probably 95 per cent. of all cases. These groups can be differentiated not only by the mechanism of their production, but to a great extent by the type of individual in which they occur, one group being more frequent in the young and healthy, another group being more frequent in the later years of adult life, and another more frequent in disease of the heart muscle and valves.

These three groups I will describe under the headings of: (1) Sinus irregularity; (2) extra systole; and (3) auricular fibrillation. I enter somewhat fully into their cause and the means of recognising them, for, with a thorough knowledge of the irregularity, one is the more able to separate those that need treatment from the great majority that require no special treatment.

Sinus Irregularity.—This form of irregularity is characterised by a varying duration of the cardiac cycle, the difference in time being due to the varying lengths of the diastolic period. It is only present when the patient is at rest, disappearing in an increase of the heart's rate from any cause, such as exertion, excitement, fever. In the great majority of cases it is respiratory in origin, the rate asing during inspiration and diminishing during expiration, occasionally the reverse may be found, the rate quickening ng expiration, or no distinct relation between the arrhythmia definite phases of the respiratory cycle is found, as in 6. At other times, though probably respiratory in origin, it t so entirely, and may occur altogether independent of the iration, especially when artificially induced by means of digi- . In rare instances, periods of slowing may occur with no ion to the respiratory rhythm and quite independent of it. It generally be recognised by the finger on the pulse or by listening e heart sounds, when the sounds of each heart beat will be d clear and distinct and no difference or a very slight difference een the first and second sounds, however varied the duration e cardiac cycle may be. Graphic records, especially of the



6.—Shows the irregularity characteristic of sinus arrhythmia (youthful type of regularity). The irregularity appears at fairly regular intervals, but the respiraory phases are more frequent than the irregular pulse period.

l and jugular pulses, may be necessary to appreciate the rare s where the slowing is independent of the respiration.

he arrhythmia occurs mostly in the young, from the time the t begins to slow down in early childhood till between twenty thirty years of life, though it may persist beyond thirty years. curs very markedly after the subsidence of a febrile attack, or n the heart has slowed down after exertion. If not present, it often be induced by slow deep respirations. The cause of this ythmia is in all probability vagal stimulation, the vagus being d upon by the respiration. It is present often in the dog and ppears after section of the vagus. It is a slowing of the whole t, the auricle and ventricle both being affected, and it is med that this variation in the rate arises from the action of the s in the starting place of the heart's contraction, in the remains e sinus venosus, hence the term "sinus irregularity.

This condition calls for no treatment. If the individual shows at the same time any evidence of weakness, treatment should be directed to restoring his general state of health but not to the heart. In fact, so far from being evidence of a heart affection, it will be found to be an evidence of a healthy heart muscle, for so far I have not found it in any cases of serious affection of the heart muscle. The reason for this is that the vagus only exercises this control when the heart muscle is healthy and free from outside stimulation.

Extra Systoles.—By far the most frequent form of heart irregularity is the occurrence of a premature contraction of the auricle or ventricle or both together, before the stimulus for contraction comes down from the normal starting place. These premature contractions are called extra systoles (Fig. 7). They may be detected by the finger as small beats followed by a long pause. The beat succeeding the pause may be big and full. Sometimes the small beats are not detected and then the impression is given that the heart has dropped a beat, and the pulse is spoken of as "intermittent" (Fig. 8). If the heart is auscultated while extra systoles are occurring the sounds produced by the extra systoles are easily recognised, two short sharp sounds occurring too soon and followed by a pause. Occasionally there is only one of the sounds present, and sometimes no sound can be detected during the long pause. The extra systoles may occur at rare intervals, or after every few beats, or every second beat may be an extra systole (pulsus bigeminus) or every third, fourth or fifth beat. They may be present at every examination, or what is more common they may appear for a time and then disappear for long or short periods.

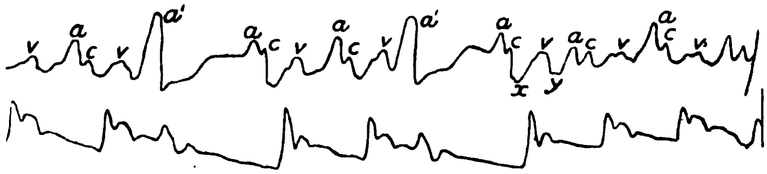


FIG. 7.—Simultaneous tracings of the jugular (upper tracing) and radial pulses. In the radial pulse are seen two small beats followed by a long pause. These beats are due to the premature contraction of the ventricle (ventricular extra systoles). It will be observed that the waves in the jugular due to the auricle (*a* and *a'*) pursue an unaltered rhythm.

Usually the patient is unconscious of their presence and is alarmed at his doctor's telling him that he has an intermittent or irregular heart. The patient may be conscious of the pause and feels frightened lest the heart should stand still, or he is painfully conscious of the big after-beat. As these extra systoles occur frequently during the night, when the heart is otherwise acting slowly, patients, particularly neurotic patients, are greatly distressed.

For the vast majority of individuals these extra systoles are of no serious significance, and the treatment should begin by a confident assurance that they are in no sense of any serious importance. In certain individuals tobacco or some digestive disturbance or some article of food, as tea or coffee, predisposes to them, and the alteration of the diet and the omission of the offending article is quite sufficient to stop their occurrence.

In neurotic people, when the occurrence causes distress, especially in the night, pretty full doses of bromide of ammonium (20 gr. two or three times a day) usually give relief. In the vast majority of cases drugs are of no use in stopping them. Many drugs have a reputation for stopping them, even digitalis, which readily provokes

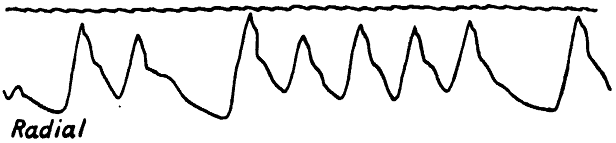


FIG. 8.—Tracing of the radial pulse showing long pauses, or intermissions, due to extra systoles. The extra systoles cause a small ram in the descending line during the intermission which was not perceptible to the finger.

hem in some people, but it will be found that there are periods uring which the extra systoles are of frequent occurrence and ong intervals when they are absent, and the cessation of the extra ystoles are in these cases quite independent of the drug. When e extra systoles persist for months and years no kind of treatent appears to be of use in stopping them. I have carefully shed many kinds of drugs in these persistent cases, and could d none that had any effect.

Auricular Fibrillation (Nodal Rhythm, Continuous Irregurity of the Heart).—There is one important group of patients whom the most typical symptom and the one easiest to recognise continuous irregular action of the heart, an irregularity which it ifficult to characterise otherwise than by the term "disorderly," a better appreciation of this disorderly irregularity can be ined by looking at such tracings as are shown in Figs. 2 to 5. hese tracings cardiac cycles are seen to be continually varying in length, and no beats of exactly the same length follow one another.

This condition has been an object of special study by me for over twenty years, because I have found that 70 to 80 per cent. of the cases with really serious failure of the heart belonged to this class. The chief clinical feature I have found in the study of the cases was that, as soon as the irregularity appeared, all evidence of the auricular systoles disappeared. For many years I wondered what had happened to the auricle. In the first post-mortem examination I made of one of these cases, I found the auricle greatly distended and thin walled, and I supposed the auricles must have been paralysed, and in my book on the study of the pulse (1902), I ascribed the condition to "paralysis of the auricle." Later I found cases which I had watched for years, in which I had seen the onset of this irregular action and at the post-mortem examination the auricle was found hypertrophied. I reasoned that, being hypertrophied, it must have contracted, and as it did not contract during ventricular diastole it must have contracted during ventricular systole. I inferred that the starting of the contraction must be somewhere that would affect auricle and ventricle simultaneously, and I suggested the node of tissue in the auricle from which the auriculo-ventricular bundle springs, and gave to this condition the name of "nodal rhythm."

In 1906 Cushny and Edmunds suggested that some of these cases might be due to auricular fibrillation, a condition where the individual muscle fibres of the auricle wall are contracting and relaxing independent of one another, but so rapid and disorderly that the result is practically a standstill of the auricle as a whole. In 1906, I detected evidence of the auricular fibrillation in some jugular tracings, but I did not fully realise the significance of these tracings till Lewis, in 1909, showed the exact resemblance between this condition produced experimentally and the clinical condition, not only by means of the graphic records of the arterial and venous pulses in animals but also by the electro-cardiograph.

The recognition of this condition is of the greatest importance, because the starting of auricular fibrillation is often the immediate cause of extreme heart failure and of death. As I have already said, the majority of cases of serious heart failure are associated with this condition, and in many cases it is the direct cause of the failure. Once we recognise the condition we can often do a great deal of good by judicious treatment.

This irregular action generally arises in connection with two morbid states: (1) In rheumatic hearts, most commonly those having mitral stenosis; (2) with fibrous change in the heart muscle in the late years of life. There have been found in all the cases I have had examined, both in rheumatic hearts and in the senile form, fibrous or inflammatory changes in the heart muscle wall of both auricles and ventricles, and it is likely that this may be the immediate cause of the fibrillation.

To understand the treatment of these cases it is necessary to realise how the irregularity is produced. Normally the stimulus for contraction arises at the mouth of the superior vena cava, and the stimulus passes to the auricle which contracts and excites the node of tissue in its wall, from which the auriculo-ventricular bundle arises. From here the stimulus passes by the auriculo-ventricular bundle to the ventricle whose contraction normally follows after the auricular contraction. But in fibrillation there seems to arise in the auricle a continuous shower of stimuli which falling upon the node, excites it to send stimuli to the ventricle as rapidly as the bundle or the ventricle is capable of taking them up. Hence in the first onset of fibrillation we may find the ventricular contraction very rapid and irregular. If the rapid action persists the ventricles become exhausted and the patient may die in a few days or in a few months after the event. If, however, from any cause the ventricle can be made to beat at a lower rate then the patient may lead a useful and even vigorous ife for many years. In some cases the fibrillation does not ause a very rapid action on its inception, while in a few it may ctually be accompanied by a diminished rate (I have published a ries of such cases under the term "Nodal Bradycardia"). The ason for this slow rate seems to be an accompanying affection of e bundle which delays the conduction of the stimulus from auricle ventricle.

The onset of this irregularity is usually quite sudden. In some es it starts with a rapid action of the heart and the patient is scious of a fluttering in the chest and the pulse is found to be id and irregular. This may last for a few minutes, hours, days, ks or even months (*see* Paroxysmal Tachycardia), and the rt may at any time suddenly revert to its normal action. On other hand, the rapid irregular action may persist and the nt's strength be speedily exhausted, so that within a few hours s conscious of breathlessness and is forced to keep his bed to sit upright with laboured breathing, while dropsy may lily supervene. These results may come on more gradually, ll stages may be met with up to cases where the patient te unconscious of any impairment of his strength.

In the heart itself changes may occur. A presystolic murmur which may have been heard disappears and the heart may dilate. It is the combination of dilatation of the heart and rapid rate that are the chief indications of grave significance.

The reason that I enter into this explanation and dwell upon the different types is that from the study we get grounds for a rational treatment. Drugs of the digitalis group act often by depressing the conducting power of the auriculo-ventricular bundle, probably through vagus stimulation, or it may be the digitalis acts on the ventricle, dulling its sensitiveness. Recognising that the rapid rate of ventricular contraction leads to exhaustion, and that those cases in which there is no increased rate do not suffer from serious heart failure, the best way to save the ventricle is to diminish its rate. This digitalis often does in a remarkable manner.

The most grave sign in this form of heart irregularity is increased rate, 110 to 150. If this rate is not reduced the patient drifts inevitably to a fatal issue. To reduce this rate digitalis should be pushed vigorously until a physiological reaction is produced or until the pulse rate comes down under 80 beats per minute. I usually give 15 to 20 min. of the tincture three or four times a day and look for good effects in three to five days. If it cannot be tolerated because of nausea or diarrhœa I substitute tincture of strophanthus (given in doses of 20 to 30 min.) [U.S.P. 5 to 7½ min.], or tincture of squills, and steadily push them until a reaction is obtained. In the majority of cases, especially those with a rheumatic heart, these drugs act well, in some cases with extraordinarily good effect (*see* Figs. 2 to 5).

Whenever a suitable drug which acts beneficially upon the heart is found (and in the vast majority of cases a digitalis preparation is the best) that dose should be administered which best keeps up the good effect. In finding this, the patient's sensations are often the best guide. Usually he speedily knows when his heart is failing, and can regulate the drug so that the best effect is maintained.

In addition to the prescription of drugs the patient should be treated according to the degree of heart failure present. If breathless or dropsical, he should be kept in bed and attention paid to his diet, sleep and so forth, as already described. If able to go about, the amount of exertion should be strictly limited to what he can do without distress. This amount is so variable that each case must be taken on its own merits and the whole circumstances considered. Many patients need only a very slight restriction, while others are quite unconscious of the onset of the irregularity, l pursue even laborious occupations with no discomfort, perhaps y conscious of a slight limitation on going up a hill. When s discovered accidentally and the patient is not inconvenienced it there is no need to employ any form of treatment, and patient should simply be warned not to do work or expend his rgy when it entails symptoms of exhaustion.

'he foregoing gives briefly the results of treatment according to erience at present. A far more effective result would doubtless)btained if we found a means of stopping the fibrillation, but far all measures to this end have failed.

t must always be borne in mind that this irregular rhythm is n associated with degenerative changes in the heart muscle and res and that the extent of these changes is an important factor he determination of the prognosis.

'achycardia.—In all cases of tachycardia a search must be le for the cause, for treatment directed merely to the rapid heart on will certainly fail. If it can be attributed to the condition mentioned (auricular fibrillation) the treatment should follow t described. If it is due to some non-febrile state, such as irs in neurotic people, then the treatment should be directed to nervous system. In obscure cases the possibility of poison, ;icularly from alcohol, or from tuberculous and malignant ases, should be considered.

1 febrile cases manifestly some cause is at work, and the sideration is directed to finding out whether the increased rate ue to an infection of the heart itself or is provoked by the eased temperature. It is useless in these cases to try and slow heart's action with drugs that act upon the heart; the treatment ild be directed to that febrile condition which induces the :t's rapid action.

persistent tachycardia may arise from the heart's contraction ting from some place other than normal, and it is difficult ecognise this unless tracings of the jugular pulse are obtained, 'hich the usual sequence of events characteristic of the normal ilar pulse is no longer present, or by means of the electroiogram. If with the persistent rapidity there is also much tration it is imperative that the patient should have rest and treated on the lines laid down for extreme heart failure. ept when this is due to auricular fibrillation, the action of edies is most disappointing. In such cases I have pushed to limit all sorts of drugs that we know to have an effect on the t, and the only success I have obtained has been with digitalis ıll doses and steadily pushed until a physiological reaction was produced, and repeated if it fails to affect the heart in the first instance.

Paroxysmal Tachycardia.—There are a great number of very obscure conditions which provoke the heart temporarily to a greatly accelerated rate. There are cases in which the rate is increased from direct stimulation, as in response to effort, excitement or indefinite causes, and in these the heart's chambers contract in a normal manner. These may appropriately be called cases of palpitation to distinguish them from cases of paroxysmal tachycardia. In late years, by means of graphic records and the use of the electro-cardiograph, we are able to recognise a number of cases, characterised by rapid action of the heart coming on suddenly, stopping suddenly, where the contraction arises in some place lower down in the auricle or ventricle than the normal starting place at the mouth of the superior vena cava.

The rates vary from 110 to 200 beats per minute; I have met with only one case with a rate of 300 beats per minute.

The patients are often conscious of the onset of the attack, and are perforce compelled to go about very quietly and even to lie down while the attack lasts.

The treatment of these cases is one of the most difficult problems. The patients have frequently some expedient which they employ and which stops the attack, as by bending down and taking a deep breath, by making themselves vomit with the finger or by ipecacuanha, or by taking a glass of raw brandy. Frequently these expedients fail and the patient has to wait till the attack subsides of itself.

Many remedies have been suggested to cut short the attacks, but I have little hesitation in saying that no remedy has yet been found of any use. When the attacks have ceased after the employment of some remedy, it has been because the attack has spent itself and the cessation has been independent of the remedy, and this view the patient will ultimately endorse. I think it well to insist upon this, for then we may be the more active in an inquiry into the nature of these attacks and a means to stop them.

While the attack is on the patient instinctively himself seeks rest, and the quieter he is kept the less exhausted does the heart become. If the attack persist for days and sleep cannot be obtained, then sedatives, as chloral or a preparation of opium, should be given. If it is accompanied by dilatation of the heart, and evidence of heart failure, such as cyanosis and turgidity of the face and lips, enlargement of the liver and dropsy, then the treatment should follow the lines laid down for extreme heart failure and drugs of the digitalis group pushed till a physiological reaction appears or he may be bled.

In spite of all treatment the accelerated rate may cease to be paroxysmal and become continuous and the patient may drift to a fatal issue.

There are often circumstances that in some cases seem to provoke attacks, such as indigestion, constipation, errors in diet, effort, worry, sleeplessness, unpleasant dreams, and any of these should be carefully considered and treated. Amongst many remedies I have tried for the purpose of preventing the attacks, bromide of ammonium is the only one I have found useful. Many patients do have fewer attacks when they are on the bromide, though it does not stop them altogether. I give it usually in doses of 20 gr. three times a day for four or five days, then once or twice a day, being guided in its continuance by its effect upon the patient. Recently in two cases I seem to have found some benefit from the use of digitalis steadily pushed for a long period.

HEART BLOCK.

Adams-Stokes' Syndrome.—The stimulus for contraction normally passes from the auricle to the ventricle through the narrow bundle of muscle and nerve fibres called the auriculo-ventricular bundle. If this bundle is damaged, the transmission of the stimulus is hindered, so that there may occur a delay in the contraction of the ventricle, or the stimulus may fail to get through and the ventricle misses a beat. This latter result may occur at rare intervals, or the ventricle may respond only to every second r third auricular contraction (partial block). Finally the lesion nay break through the bundle and prevent the transmission of all timuli from auricle to ventricle, and the ventricle then contracts ndependently with its own independent rhythm, which is usually bout the rate of thirty beats per minute (complete block).

The slighter forms of partial block can only be recognised by eans of graphic records. The more advanced forms of partial ock and complete block can be recognised by the fact that the ricular pulsations in the jugular are more frequent than the ntricular contraction. When the ventricular rate falls under rty it may safely be assumed that complete block is present, wing to this extent from any other cause being extremely rare.

he lesions causing the block are usually changes invading bundle. In acute cases cellular deposits have been found. hilitic gummata have also been found affecting the bundle producing heart block.

Usually no symptoms characteristic of this condition are produced, except it may be the too speedy exhaustion of the work force of the heart, until complete heart block sets in. When this occurs the patient usually becomes easily exhausted, and in some attacks of loss of consciousness, slight or prolonged, with convulsions (Adams-Stokes' syndrome) may occur at intervals, more or less frequent. The immediate cause of these attacks is the slowing of the ventricular rate to such a degree that anæmia of the brain results in the loss of consciousness.

The period of greatest liability to these attacks is the time when the block first becomes complete. In experiment it is found that when the auricle is separated from the ventricle the ventricle may stand still for a period before it takes on its own rhythm. The same thing happens in heart block, and in some patients periods of partial and complete block occur, and at the beginning of the period of complete block these syncopal attacks are prone to appear. In rare cases with complete heart block periods of slowing from undiscoverable causes occur, during which these attacks supervene and death may ensue.

It is only in cases where there is ground for suspecting a syphilitic lesion that treatment is of avail in removing the cause of the block. When there is a syphilitic history or a suspicion of it a thorough anti-syphilitic treatment should be carried out. There are records of a few cases of recovery seemingly due to treatment of the syphilitic affection.

In regard to the milder forms of partial heart block, the heart block is not the factor which is the object of treatment, but such form of heart failure as may be present. It must, however, be considered in the application of treatment, for its presence may modify the action of drugs of the digitalis group. This kind of drug is not necessarily contra-indicated, but its action should be carefully watched lest the block be increased, by its tendency to depress the conducting power of the auriculo-ventricular bundle (*see* Fig. 1).

When the slowing of the ventricular rate is due to partial heart block, drugs, such as atropine, have been used to paralyse the vagus, and in some instances the rate of the ventricle has for the time being been increased. But no permanent improvement can result from this line of treatment. I have also seen a two to one rhythm revert to the normal rhythm for a brief period on the administration of massive doses of oxygen.

To prevent the ventricle becoming too slow in its action when there are intermitting periods of partial and complete heart block e drug which excites the ventricle should be given, but we have yet found an efficient remedy, though Cushny has suggested leborein. I have used this but without effect, the dose ($\frac{1}{100}$ gr.) ng probably too small. When the block is complete and there vidence of heart failure, dropsy and exhaustion, drugs of the talis group may be safely employed, as they do not slow the tricle when it is contracting in response to its own stimulus.

)uring these periods when attacks are likely to supervene the ient should be kept very quiet in bed, or moving about very efully. If fairly free from them, and it is necessary he should ıbout, he should always be attended by some one who is on the ch.

'he slighter attacks of loss of consciousness are soon over and hing need be done for them. During the severer attacks the ient should be laid in the recumbent position and all obstruc- ı to the free respiration removed. He should have plenty of h air and, if feasible, oxygen in large quantities should be aled. As I have said, no remedy has been found that will te the ventricle to greater activity, though many so-called cardiac tants (strychnine, caffeine, spermin) have been tried. Injec- ıs of atropine may be tried lest there be some over-action on part of the vagus nerve.

VALVULAR DEFECTS.

have already pointed out that valvular affections should be sidered only so far as they are indications of a progressive on affecting the heart and blood-vessels, or if they embarrass heart in its work. When, therefore, we detect a valvular rmur, three points have to be considered : (1) Does the murmur icate such a lesion of the valve that the heart is obstructed in work ? (2) does the presence of the murmur imply an active cess going on in the heart? (3) has the lesion that has affected valve also affected the muscle of the heart? The careful clini- ı will have little difficulty in determining these points, and urally the treatment will be guided by the answers.

n regard to the first question, if we detect a murmur at any ice and we find the heart's power of response good and no lence of exhaustion, then no treatment is called for, so far as heart is concerned. If there is evidence of exhaustion, very eful discrimination should be made to find out if the defect is ly the cause, before treatment is especially directed to the heart. ny people have heart murmurs and many people suffer from austion from the many causes which arise in a strenuous life. Such exhaustion may often be independent of the valve defect, and the treatment should be directed towards restoring the patient's strength by means of other than special heart treatment. When, however, we find that undoubtedly the valve lesion has so obstructed the heart that exhaustion has resulted, then we have clear lines to follow. The exhaustion has in all probability come about in consequence of the individual endeavouring to keep up his work at the level of one with a sound heart, so that his handicapped heart ultimately gives out. The treatment, then, should follow the principles already laid down in describing the effects of rest and drugs.

If in a reply to the second question it is found that the murmur implies active change, then perfect quiet and rest is imperative and every means should be adopted that will give the heart complete rest. If there is any fever or causative factor, then treatment should be specially directed to this.

The third question deals with what is called "chronic valvular cases." The valvular murmur being such a dominating symptom to the physician, his attention is diverted from what is often the real factor in the heart failure, namely, the condition of the heart muscle. It probably never happens, with chronic valvular affection in severe heart failure, that the disease is limited to the valves alone; such heart failure is always accompanied by change in the muscle, and this really constitutes the source of danger. The evidence of the muscle failure is manifest by changes in the size of the heart and in the movement of the heart, and in its rhythm and rate.

MYOCARDIAL AFFECTIONS (DILATATION, HYPERTROPHY, DEGENERATION).

It is rare that we have to treat a heart affected by dilatation alone. Except in febrile conditions or in poisoning, or in anæmia, we rarely find dilatation without hypertrophy or degeneration.

When dilatation occurs in acute febrile affections of the heart or as a result of some poison or mal-nutrition, generally all the cavities are affected simultaneously. This also happens when there is dilatation of the heart from most other causes; the whole heart gives way, as in advanced failure of old-standing rheumatic heart cases and in auricular fibrillation.

The line of treatment of dilatation will be found to depend on the causes inducing it, thus in febrile affections the treatment is directed to the cause of the fever. In a series of cases I observed in Lancashire, during the time that the beer was contaminated with arsenic, I saw a number of beer-drinkers with extreme heart failure and dilatation. A number of hearts quickly regained their normal size when the patient ceased to drink the arsenic contaminated beer. I have seen a number of rapidly fatal cases of heart failure presenting only symptoms of great dilatation, and, from their resemblance to the arsenical cases I have supposed that some poison has affected the heart muscle. In all cases of dilatation with no history of old-standing heart trouble it is always well to inquire into a possible source of poisoning, and particularly an alcoholic or bacterial source. Treatment should then be directed to the removal of the cause. In simple dilatation from the anæmias, as in chlorosis, malaria or malignant anæmias, the treatment should be directed to the anæmia.

It may be well to state that treatment by the use of so-called "cardiac" drugs, as the digitalis group, strychnine, carbonic acid baths, will be so much waste of time in these cases. If the cause of the dilatation cannot be ascertained, it is far better to treat the patient on lines that will improve the health of the patient as a whole.

Dilatation associated with old cardiac lesions, valvular or nuscular, should be treated as part of the conditions in general ailure of the heart on the lines already laid down by rest and igitalis if necessary. It is remarkable, however, how responsive treatment the dilatation associated with chronic valvular disease to the digitalis group of remedies.

Hypertrophy of the heart calls for no special treatment. When is physiological in response to some healthy form of effort it ay be necessary to caution the individual against too long an dulgence of the effort. Otherwise hypertrophy is an evidence some inherent defect in the circulation, as in valvular disease and gh blood pressure or arterial disease, and it is a sign for treatnt to be directed to lessening the work of the heart by making s calls on it, by modifying the daily life of the individual and removing the causes of high blood pressure as far as possible.

When our attention is called to hypertrophy it is generally ociated with some more or less degenerative changes, and the rt is no longer able to maintain an efficient circulation, while patient's field of response has become so restricted that he orced to seek advice. The symptoms presented may be very ed and they give indication for special treatment, as angina oris, cardiac asthma, Cheyne-Stokes' respiration, dropsy, etc., under these headings certain directions are given. The ral plan of treatment should, however, be carried out as ated in dealing with the principles of heart failure.

Fatty degeneration of the heart cannot be diagnosed with certainty, but where it is suspected we should distinguish between a heart that is loaded with fat and one where the fibres are degenerated. In the former case more vigorous exercise in the open-air should be taken, and by dietetic means the amount of bodily fat reduced. When we suspect fatty degeneration more care has to be exercised. If the patient has been taking little exercise, then exercise judiciously undertaken in the fresh air, gradually to train the heart, may do much to flush the heart with healthier blood and re-invigorate such of the fibres as are not too far degenerated. Even in patients seemingly crippled the response to such treatment is surprising. Other measures to promote a healthy life should be prescribed.

ACUTE FEBRILE AFFECTIONS OF THE HEART.

In considering acute infection or febrile affections of the heart it is best to consider the condition of the heart as a whole and not to divide the affections into endocarditic, myocarditic or pericarditic affections. In doing this we shall appreciate the importance of symptoms and view them in their proper perspective, on the one hand not unnecessarily alarmed by the presence of a murmur or lulled into false security by its absence. In this connection it is necessary to bear in mind that, murmur or no murmur, friction sound or no friction sound, an increased size of the heart means a myocardial affection, and the affection of the myocardium is in many cases a graver condition than the endocarditis or pericarditis which may happen to be present. It is necessary, therefore, that in all acute affections of the heart the size of the heart should be carefully watched.

Acute febrile affections of the heart are due to the invasion of the heart by some microbe. Rheumatic affections are by far the most common cause, though the specific organisms of erysipelas, pneumonia, diphtheria and other infective complaints may invade the heart.

In addition to the treatment directed to the specific fever with which the body is assailed, the heart condition should be carefully watched. The body should be kept at rest and made comfortable, sleep should if possible be ensured, and careful attention paid to the digestive system, the mouth cleansed, food given in small quantities and when possible well chewed, so as to keep the mouth clean and prevent flatulent distension. The bowels should also be carefully regulated.

In the febrile stage drugs, such as digitalis, are of no use and should be withheld. There is usually no indication against pushing the salicylates in rheumatic fever, especially as there seems reason to expect that its beneficent action in rheumatic fever may be by acting on the specific cause of the fever, whether located in the joints or in the heart.

It is impossible to tell in many cases whether the heart itself is invaded by the microbe producing the fever, nor do the symptoms present, as a rule, help to a decision. It is necessary, therefore, to bear in mind that, apart from such definite signs as are caused by emboli or pericardial friction, the heart in the febrile state may become dilated, increase its rate and show murmurs, with no invasion of the heart by any specific organism, the rise in temperature being apparently sufficient to produce these symptoms.

This has to be considered when the question of after-treatment arises, for the heart quickly recovers when it is merely affected by the febrile state.

When, however, we are convinced that the heart has been invaded by a morbid process, as after rheumatic fever, then the patient hould be kept quiet for a long time after all the febrile symptoms have disappeared. It may be months before the heart muscle has ecovered, and if exercised before the inflammatory changes have isappeared permanent enfeeblement of the heart may follow. he subsidence of the dilatation and the gradual return of the ork force will be the best indication when restrictions should be laxed. In addition to the treatment of the heart by rest, treatent directed to the improvement of the patient's general health ould be carried out. (*See also* Acute Endocarditis.)

DROPSY.

One of the most striking symptoms in heart failure is "dropsy." thout dealing with the many speculative views concerning the chanism by which dropsy and œdema are produced, we may take that it is an evidence of heart failure, that is, when it is not asioned by some other cause, as kidney disease or mechanical truction. Usually it is accompanied by a diminution of the ount of urine, and there is without doubt a connection between two circumstances. The method of getting rid of the dropsy o increase the efficiency of the circulation and the flow of urine. n the earlier stages of its appearance it may be found that the rt is not able to respond to effort and at the same time to carry an efficient circulation, and dropsy may appear. With the ng of the heart's work the dropsy disappears. This may be ined by diminishing the amount of work, as by rest in bed, or even by reducing the bodily weight in fat people. With persistence of the dropsy, notwithstanding these milder efforts, the employment of the drugs of the digitalis group is often followed by marked disappearance of the dropsy, either when given alone or combined with other drugs, as the calomel and squill and digitalis pill.

When the dropsy refuses to yield to this line of treatment restriction of the amount of fluids should be tried. A stage is ultimately reached when remedies are of no avail, notwithstanding that many forms of treatment are specially lauded for their action on dropsy. In some cases the elimination of common salt from the diet seems to do good, and in others such drugs as diuretin, or theocin-sodium acetate, seem to help when other remedies fail. But dropsy is occasionally very variable in its response to treatment, at one time yielding to almost any kind of treatment, at another most resistant till a certain stage is reached, or until certain unknown circumstances occur, when it will suddenly yield to some very mild treatment, or even when no special treatment has been employed. Thus a patient may lie for weeks dropsical and the heart weakness extreme and unyielding to all forms of treatment, so that special treatment may be suspended. After a time the urine will begin to flow and the dropsy gradually disappear and the patient makes a permanent recovery. A mere change in the position may have the same effect on the dropsy. I have seen a patient who has had to sit up in a chair for three weeks, on account of his breathing, become extremely dropsical, and passing very little urine. The return to bed was followed at once by a profuse diuresis and the rapid disappearance of all the dropsy. It is because of this tendency of dropsy to disappear suddenly with the aid of some stimulus that the wonderful results are attributed to certain drugs or methods of treatment.

In all cases the bowels should be kept freely moved if the patient's strength permits.

Stages are however reached when nothing seems to help, so that special efforts to give relief have to be resorted to. In certain cases, when the patient can go about, an elastic bandage skilfully applied is beneficial, particularly in those hard swollen legs when the skin threatens to give way. Massage is also of assistance when the legs or genitals become greatly distended; deep pricks with a needle will often be followed by a free flow of serum and a great diminution of the swelling. The utmost cleanliness should be observed in carrying out this simple procedure. The employment of Southey's tubes, inserted in the legs or abdominal cavity, will often drain off a large quantity of the fluid. The abdominal and thoracic cavities may need to be tapped; such tapping invariably gives temporary relief. In some advanced cases when the penis is greatly swollen there may be inability to void urine. In using a catheter there may be some trouble in finding the meatus, the glans penis being buried in the scrotum by the greatly distended prepuce. If the swollen foreskin is gently but firmly grasped in the hand and compressed the fluid is driven out and the glans can then be exposed.

The employment of judicious breathing exercises in œdema of the lung is often beneficial, the patient sitting up and breathing slowly and deeply. In severe cases this is limited at first to a few movements. If the patient bears the exercise these deep respira-
ions should be employed at regular intervals every two or three
ours when awake. In the intervals the patient should be propped
s high as he can bear with comfort.

TREATMENT OF SUBJECTIVE PHENOMENA.

So far I have been discussing the treatment of symptoms
served by the physician, and it is necessary to consider the
bjective sensations of the patient as a guide to treatment. I have
eady pointed out that our knowledge of the extent of heart
lure is best attained in the majority of cases by recognising the
ure of the patient's sensations.

There are a number of sensations of such a characteristic type
t they offer good grounds for the application of treatment
able for the condition that calls them into being. Under this
ding I propose to discuss the treatment of angina pectoris and
r sensations induced by the heart which are usually included
er the term "neuroses."

onsciousness of Heart Trouble.—The consciousness of heart
ble has often a depressing effect on people, whether the trouble
ight or serious. When such people become convinced that the
le is curable and not serious their condition at once becomes
ly improved. Cures by faith, whether in drugs, baths or
rate methods, or religion, act by playing upon the mental
tion. We should always study the mental condition of the
t and its bearing upon his complaint, and we should utilise
culiar features in treatment. But our employment of this
t in treatment should not be the outcome of blind unreason-
ith in some rite or ceremony, bath or drug, but in the
gent perception of the nature of the symptom. The reassur-
the patient of the harmless nature of the complaint goes a

long way towards curing him. When there is some affection that cripples him the reassurance that, with reasonable care, no danger need be feared, is extremely helpful. Even in serious cases, when there is reasonable hope of recovery or a certain degree of recovery, the encouragement of the patient may and does help forward his improvement.

The mental factor, on the other hand, should make us very chary of giving a gloomy prognosis. There is nothing in my experience so surprising as the manner in which the heart can recover from the seemingly most hopeless condition of exhaustion. And we must bear in mind that a gloomy view may in itself nullify the best attempts at treatment. We should aim at getting the patient into a placid, contented, hopeful frame of mind, so that the heart is not disturbed by emotional reflexes.

Angina Pectoris.—For the purpose of finding a rational therapy I include under this section all forms of pain and discomfort, such as constriction of the chest, sense of suffocation, sense of impending death, which have their cause in some cardiac condition. The pain when present is usually recognised as being of cardiac origin, when it is restricted to some part of the region of the peripheral distribution of the spinal nerves whose centres in the cord are in close association with the sympathetic nerves supplying the heart, namely, the two lower cervical and the upper four dorsal nerves. The pain is usually on the left side, embracing the chest and the inner side of the upper arm and ulnar border of the forearm and hand.

Sometimes the pain may be felt in the neck and jaw (*i.e.*, the peripheral distribution of the upper cervical nerves, probably in association with the vagus centre) (Fig. 9).

Taking the symptom of pain in this region as a basis, we find it always occurs in association with the exhaustion of the heart muscle, whatever may have been the conditions that have led to this exhaustion. It is, in my opinion, of importance to recognise this relation between angina and exhaustion, for we are at once given a safe guide to treatment, the practical indications being to restore the exhausted muscle and prevent the recurrence of this condition.

There is another factor involved which is also of prime importance, viz., the nervous system. From a variety of unknown causes some people seem to have pain more readily provoked than others, as is seen by the fact that lesions, seemingly identical, give rise to different nervous phenomena in different people. Moreover, as a matter of experience, not only may pain be more readily produced in some people than in others, but once a tendency to attacks of pain is established, the attacks become more easily provoked. The recognition of this helps us in two ways, first, in recognising the fact that the severity of the pain is no guide to the gravity of the lesion; secondly, treatment directed to the nervous

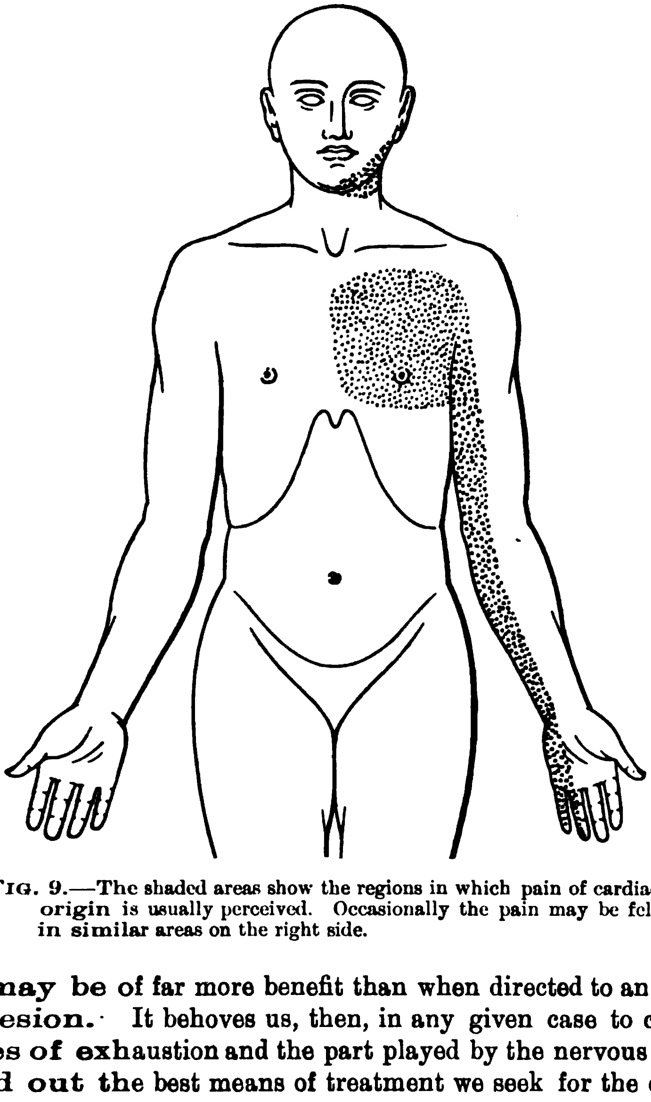


FIG. 9.—The shaded areas show the regions in which pain of cardiac origin is usually perceived. Occasionally the pain may be felt in similar areas on the right side.

n may be of far more benefit than when directed to an evident
c lesion. It behoves us, then, in any given case to consider
ses of exhaustion and the part played by the nervous system.
ind out the best means of treatment we seek for the cause of
tion. This is, as a rule, not a difficult matter, and here I
te the manner in which this may be done.

The most common form of angina appear between the ages of fifty-two and sixty-five, and in these cases we have to consider what may have induced the exhaustion. We know that in many people at this time of life changes have taken place in the circulatory apparatus which are due to advancing years, aggravated, it may be, by the kind of life that has been followed. We therefore carefully inquire into the life history, and may likely find that the patient has been leading a strenuous life for a great many years, doing as much as in the prime of health, thrusting from him the indications of heart exhaustion. If careful inquiries be made some symptoms of discomfort, such as a slight tightness across the chest or breathlessness, have appeared at intervals long before the onset of the pain which forced him to seek advice. Manifestly here, then, the exhaustion has come through a long-continued strain, and the possibilities are that some relief being given, the heart will regain its strength and the distressing phenomena disappear. In such cases it is not necessary to stop a business man from doing all his work. To do so may affect his circumstances most seriously, and his business affairs may be unnecessarily jeopardised. It may be quite sufficient for him to omit some of his less pressing duties, and the relief thus obtained may be quite sufficient.

As a rule, it is best for him so to arrange his affairs that he can take a restful holiday with his mind at ease. The holiday should be spent in that manner which affords the maximum of enjoyment with the minimum of effort. If the patient has no particular bent, and if a holiday might drag wearily, he may be sent to some watering place and made to undergo the *régime* peculiar to that place. The carrying out of the directions gives his mind sufficient exercise to prevent tedium, and he will have the opportunity of reaping the benefit that the waters may possess.

In all cases the mode of living must be considered and the habits of the individual, so that excesses in diet, abuse of alcohol or tobacco should be corrected. There may be some supposed abnormality in the heart, as a murmur (an aortic systolic murmur is very frequent), or there is what is thought to be a high blood pressure, or thickened arteries may be detected. While noting such conditions, treatment should not be directed to their amendment alone, for they are but individual features of a very complex condition.

In cases that do not benefit from such limited restrictions and when the attacks are demonstrably the outcome of an advanced exhaustion of the heart, then more rest is required till, in extreme cases, it is necessary to confine the patient to bed. In the more

›me cases strict attention should be paid to the amount and of food, the state of the bowels, freedom from annoyance and y, while a sufficient amount of sleep should be ensured.

is only in rare cases that in spite of this line of treatment the nt gets worse, the attacks recur, and the patient finally ımbs. This resistance to treatment is an important element ıgnosis, for it will invariably be found that the lesion that has ›ed the attacks of angina is of such an advanced nature that it red the heart unfit to maintain a circulation compatible with In such cases where, notwithstanding plenty of rest and the ›tion of any errors in diet, no progress is made and the s supervene on the slightest exertion, we must recognise that ve to do with an exhaustion so extreme that its cause may be such organic changes in the blood-vessels of the heart and art muscle that no prospect of recovery can be entertained. these circumstances the patient must be kept at complete is food and his habits carefully regulated, and all circum- s likely to induce the attacks of angina avoided, while es, such as chloral or opium, may have to be administered to t the recurrence of the attacks or to lessen their frequency. before coming to the conclusion that the heart condition is diable, we must weigh carefully the possibility of the attacks more readily provoked in consequence of an exalted ibility of the nervous system. In many cases, where the ıt exertion, such as getting out of bed or walking across the ıay induce an attack, if careful inquiry is made, the patient ve passed through a period of stress, worry or anxiety, and ıve had sleepless nights. If such patients are protected eir worries and acquire peaceful and restful nights' sleep, may at once set in and proceed to a surprising extent. hen there is advanced degenerative change in the heart ›d-vessels this is found to be the case. The most useful I have found in these cases is bromide of ammonium given of 20 gr. thrice daily until a certain degree of lethargy and ss is produced. This remedy acts not only in inducing ıt in rendering the individual more indifferent to the and troubles that beset him. In some cases there are vhen the attacks of angina are liable to recur and these are by sleepless nights. The administration of the bromide e sleeplessness first appears may prevent the exhaustion duces the anginal attacks.

are a great many conditions in which attacks of angina to occur which are induced by factors which weaken the heart or the nervous system so that the latter becomes unduly sensitive. Thus overworked women, particularly about the menopause, frequently have attacks of pain of undoubted cardiac origin. Ill-nourished and anæmic people are liable to attacks, particularly if they are subjected to long and exhausting hours of labour or with disturbed nights, as in nursing the sick. Those cases so obviously demand rest and nourishment that it is unnecessary to dwell upon it further. In many of these cases where there is manifest nerve exhaustion the bromides will prove valuable aids. In its effects bromide may produce listlessness and a feeling of greater weakness, but this is no indication for its discontinuance, as the heart is being protected from exertion, and will ultimately regain some strength because of the enforced idleness.

There is a class of patients who are readily susceptible to influences which affect the circulation, especially to cold, and some are liable to attacks of angina pectoris. These attacks are more frequent or occur entirely during winter. Other patients are peculiarly sensitive to certain articles, such as tobacco, coffee, and they usually appreciate the fact that over-indulgence provokes a liability to attacks of pain of cardiac origin. The majority of these patients are of a somewhat characteristic type, spare in body, the fingers liable to become cold, and their noses red, sometimes with dilatation of the stomach and some slight dilatation of the heart, also somewhat neurotic, a class I have included elsewhere under the title "X disease," a provisional name to describe a condition the nature of which I do not understand. These patients require individual consideration, the treatment obviously depends on such circumstances as are applicable to each case, and a sensible regulation of the patient's mode of life. So far as the heart is concerned the attacks of pain are not of a grave character, and treatment should be directed to getting the heart into a good tonic condition by suitable exercises in the open-air. The indications are not for resting the heart but for improving its tone by training and judicious exercise of its functions and the avoidance of conditions which bring on the pain.

In elderly patients showing a tendency to angina pectoris, in addition to the regulation of the patient's mode of life and the removal of any accompanying ailment, such as indigestion or kidney trouble, some medicinal measures are sometimes of avail. Thus iodide of potassium is usually recommended in those with firm pulses and thickened arteries, and particularly if there is a history of syphilis. Some recommend large doses, but I have had good results which were obtained by doses of 5 gr. thrice daily.

The remedy should be given intermittently as for one week every month. In many people tonics, such as quinine or nux vomica, will help the general health.

A very important factor in treating cases with angina pectoris as well as all forms of neurotic hearts, is the mental condition. The fact that patients who suffer from angina pectoris sometimes die suddenly or die shortly after the appearance of the symptoms has so impressed the lay mind as well as the medical that a very gloomy view of the condition is taken. As a matter of experience it is only a very small proportion of the cases, even of those with severe attacks, in which there is cause for immediate concern. The vast majority of patients can recover to a very great extent and lead useful lives for indefinite periods; therefore it behoves us to make a special study of each case, and when we find the condition is of no gravity a favourable prognosis given with an air of firm conviction will at once do a great deal of good. This element of hope must be based upon a clear conception of the heart's condition, and the careful physician will have little difficulty in detecting the essential features in each case.

In certain cases where there is aortic valve disease, attacks of angina pectoris are easily provoked, and the patient's life must be greatly restricted on this account. These attacks may appear in patients between thirty and forty, where the valve disease was due to rheumatism or syphilis, as well as in the elderly, where the lesion may be due to fibrous degeneration. So severe may these attacks be, and so easily provoked, that the patients are forced to lie abed. In such cases relief may be obtained by pushing the bromides (1½ to 2 drachms a day) till a condition of lethargy is produced and the patient lies in a drowsy condition. After a few weeks the patient is allowed to come out of the influence of the medicine, and then a distinct improvement in his condition may be found. Otherwise this kind of patient is one of the most difficult to treat and liable to become addicted to the opium habit when opiates are resorted to for relief. The great suffering is consistent with a long life, and I have watched cases of this sort for twenty years.

Treatment during Attacks.—The slighter attacks of angina pectoris require no treatment. When they become more severe rapidly acting vasodilators should be administered, such as hot drinks, hot water with whisky or brandy, and best of all and most speedy, amyl nitrite by inhalation, or nitro-glycerine. The nitrites are not successful in all cases, but their action is rapid and the relief is generally complete. When they are successful, it is inferred that the patient has previously had constricted arterioles or increased arterial pressure and that the pressure was reduced and the heart was eased. This is not the full explanation in all cases. A patient with cardio-sclerosis had an attack of angina pectoris in my consulting room. I took his blood pressure and found it 190 millimètres Hg. I then administered to him nitrite of amyl. It acted instantaneously and gave him perfect relief. After fifteen minutes I again took his blood pressure and found that it had risen to 200 millimètres Hg. Though the pressure was higher, he had no pain.

Oxygen inhaled during an attack may give relief. When the nitrites fail to relieve the patient we are forced to use chloroform, chloral, or morphia, in doses sufficient to give relief. I have occasionally found that chloral acts beneficially not only in relieving the somewhat long attacks, but in preventing the attacks recurring, particularly when given at night to induce sound sleep.

Palpitation and other Neuroses.—There are a number of cardiac conditions which act upon the conscious nervous system (mental and physical) and a number of nervous conditions that react upon the heart, and these may for want of a better term be called "neuroses of the heart," though no strict definition of the term can be given. I have already drawn attention to the fact that in some people with an abnormally sensitive nervous system an extra systole or an attack of tachycardia produces distressing effects. Such abnormal heart actions are sometimes spoken of as of nervous origins, but we must recognise them as cardiac effects apart altogether from the nervous symptoms they produce. On the other hand, there are cardiac conditions distinctly attributable to neurotic origins, and of those what is generally described as palpitation is the most common.

"*Palpitation*," in the sense used here, may be described as the sensation by which the patient is conscious of the forcible or excited and usually increased rate of the heart's action. In this action of the heart the stimulus for contraction arises at the normal place, whereas in paroxysmal tachycardia the stimulus for contraction arises at some place other than the normal. Moreover, palpitation is usually induced by some stimulus reaching it by its sympathetic nerve supply, as from mental emotion or digestive disturbance. This tendency to attacks of palpitation bespeaks an excitable condition of the heart, chiefly in its regulating mechanism. From this it will be seen that the treatment must be based on two principles, the removal or avoidance of any causal conditions and the dulling of the susceptibility of the nervous mechanism of the heart. The mental state of the patient must also be considered and the condition of his bodily health. If the patient is easily upset or startled as far as possible circumstances producing this effect are to be avoided. The bodily health may be impaired, as in forms of anæmia, and treatment should be directed with the object of removing any defect of this kind. Here it may be well to remark that palpitation may be an early sign of the premature exhaustion of the work force of the heart, and the question of some real affection of the heart has to be considered. After dealing with the general health it may be necessary to treat the excitable nervous mechanism, and this can best be done by sedatives, and particularly the bromides, these being pushed until some mental dulness is produced. In very distressing cases, especially where the attacks come on in the night, more powerful sedatives may have to be employed, such as veronal, sulphonal, and even chloral or opium. These drugs, however, should be carefully watched and only used in cases of extreme need and stopped as soon as possible, lest a drug habit be created.

During an attack it may be necessary to give some immediate relief, and the most speedy means is by some hot drinks, very hot coffee often being very helpful and comforting. Brandy often gives great relief, but this must be used very rarely, as the tendency to repeated use becomes overpowering in some people, ending sometimes with the creation of the alcoholic habit. Other measures may be employed, such as a hot indiarubber bottle to the chest or hot cloths over the heart.

Other forms of obscure conditions, partly nervous and partly circulatory, are met with, as in attacks of depression, weakness, faintness, and even syncope. In many the immediate cause is the deficient supply of blood to the brain, and they are quickly restored if laid in the recumbent position. It seems in some people that there is a tendency for the blood to accumulate in the abdominal cavity, and I have found on a few occasions remarkable improvement follow the wearing of a broad abdominal belt rather tightly applied. Some women feel faint if they stand too long or if standing at the looking-glass dressing their hair, their arms are kept elevated too long, and it is possible these positions in particular favour the accumulation of blood to the abdominal veins.

Cardiac Asthma.—A form of respiratory distress which comes on usually in the night, sometimes arousing the patient from sleep, has received the name of cardiac asthma. The kind of patient that suffers from this complaint is the elderly and those who suffer from sclerotic degeneration of the heart muscle, and those who in addition have chronic kidney trouble and high blood pressure.

Relief can often be obtained at first by careful attention to the patient's meals, attention to the bowels, and getting him to lie with his shoulder well raised. If attacks keep recurring a small dose of chloral or opium on going to bed may prevent them. When the attacks are severe and do not yield to such preventive treatment various remedies may have to be tried. When the attacks last for over an hour some experience great relief by small doses of chloral and opium. In a few cases I have found great benefit from massive doses of oxygen. Even given as a preventive, I have found oxygen of use, inhaled before going to bed. In all cases where it has been of benefit there has been some degree of cyanosis.

It need scarcely be added that the appearance of cardiac asthma is often the sign of an unyielding failure of the heart, and is thus of grave prognostic significance.

Cheyne-Stokes' Respiration usually calls for no treatment, but in rare cases, during the apnœic stage, the patient may be roused by a terrible sense of suffocation. In these cases the end is approaching; oxygen and fair doses of morphia or chloral generally afford relief.

J. MACKENZIE.

CONGENITAL AFFECTIONS OF THE HEART.

In these conditions our chief aims must be to improve the patient's general condition, and to protect him from anything likely to throw an additional strain upon the heart. There is a marked tendency to bronchitis and tuberculosis. The child should, therefore, be adequately clothed and protected from the effects of a changeable climate. Both the diet and amount of exertion permitted must be carefully regulated. On the one hand we have to consider the necessity of maintaining the child's general health, on the other we have to guard against any chance of undue strain. The treatment of any complication such as heart failure must be carried out on the lines indicated for similar conditions arising in the course of other heart affections (*see* Diseases of the Heart).

ARTHUR LATHAM.

DISEASES AND AFFECTIONS OF ARTERIES.

SURGICAL ASPECTS OF HÆMORRHAGE.

By the term hæmorrhage is meant the escape of blood from its containing vessels, and this may occur, on the one hand, from traumatic causes, as is most frequently the case, or it may, on the other hand, be predisposed to by some pathological changes in the vessel walls, or in the blood itself, which favour extravasation. It is with traumatic or mechanical hæmorrhage that this article deals.

The three guiding principles to be observed in the treatment of hæmorrhage are: (1) The arrest of the bleeding, (2) the prevention of its recurrence, and (3) the adoption of such measures as will aid the individual in recovering from the effects of the loss of blood, and will restore the blood to its normal standard. Local and general measures will thus be required, and these may not merely be utilised when hæmorrhage is actually taking place, but may also be employed as a means of preventing or lessening hæmorrhage in surgical undertakings where bleeding is expected to occur.

SURGICAL METHODS OF TREATING HÆMORRHAGE.

Pressure, whether directly or indirectly applied to the bleeding point or surface, is not only the most universally effective agent for the control of hæmorrhage, but it is also the mechanical principle underlying the ligature, tourniquet, suture, elastic bandage and several other surgical devices. It should be remembered that digital pressure over the bleeding point will always temporarily check the most severe hæmorrhage, while means are being taken to effect permanent hæmostasis. This pressure may be made directly with the finger, or indirectly by means of packing with gauze or some other similar material.

Ligature.—For permanent hæmostasis, ligature has proved the most convenient method, where the bleeding originates from some definite vessel or vessels. As regards the material used, silk, thread and catgut are the materials in common use; the writer himself prefers ordinary linen thread, which is procured in three sizes, No. 60 for fine work, No. 40, and No. 18 which is the thickest, and it is sterilised by boiling for two hours, and is then stored in weak carbolic acid. Immediately before use it may again be boiled for ten minutes. It has the advantage of being cheaper than silk or catgut, it is stronger size for size when compared with silk, it can be efficiently sterilised, its surface is not slippery and pulpy, so that there is no risk of the knots becoming loose, and it is less liable to give rise to trouble when buried in septic wounds.

The artery is picked up cleanly with Spencer Wells pressure-forceps and the ligature applied around, the forceps being tilted to facilitate the process, and it is tied in a knot that will not slip. In tying a knot upon a divided vessel, sufficient pressure is applied to rupture the inner coats; this is not done for any advantage accruing from the division but to guard against the ligature being pushed off by the force of the blood, twitching of muscles or any movements of the injured part. Where ligation is done in continuity, the balance of evidence is in decided favour of tying without division of the coats. The surgeon's knot is the most secure of all, but it has the disadvantage of taking time, and, further, it throws more strain on the thread, with the result that the latter is more likely to snap. The writer, for all the smaller vessels, uses either the reef knot or the ordinary granny knot tied three times—the latter is the simplest and quickest, and the first knot can be held taut while the second knot is being tied. In the case of a bleeding point which is deeply placed, or where there is difficulty in manipulating a ligature over the end of an ordinary Spencer Wells forceps, a Lane's tissue forceps (*see* Fig. 1) may be used as a substitute to pick up the tissues round the vessel, and the ligature then applied over it and tightened, the shape of the instrument guiding the ligature into the required position.

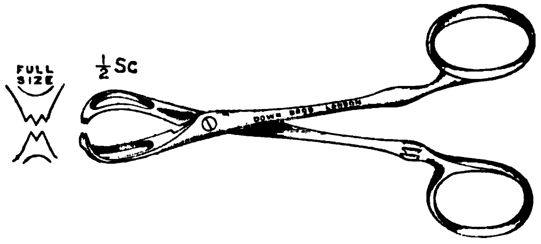


FIG. 1.—Lane's tissue forceps.

Forci-pressure—This is a method of arresting hæmorrhage by means of the strong serrated blades of a Spencer Wells forceps or some similar instrument. Arteries of any size can be permanently closed by forceps, if the latter be allowed to remain on the vessel for some hours; for example, if the renal pedicle cannot for some reason be tied with a ligature a large pressure-forceps can be left on for about thirty hours. It is said that if the forceps are left on for sixteen hours upon an artery of the calibre of the radial, the latter would be permanently obliterated, while if an artery of the dimensions of the femoral be similarly treated, for efficient permanent obliteration the forceps must be left on for about forty-eight hours.

Except in special conditions where there is great difficulty in applying a ligature, this method is not often practised, since a certain amount of tissue included in the grasp of the instrument will undergo necrosis, and the method is more painful and certainly more inconvenient. It is, therefore, only used as a temporary provision during an operation until the vessels are finally ligated or twisted. As regards the smaller vessels, these may be seized when they are wounded and the forceps left in position until the completion of the operation, when they are carefully removed; for example, it will be found that the perforating branches which require clamping in the course of a breast operation will have ceased to bleed when the forceps are carefully removed just before closing the wound, and it is but rarely that a ligature is required for the superficial vessels divided in the tissues overlying the inguinal canal during the course of a hernia operation. Two precautions, then, must be taken in using pressure-forceps: firstly, they must be left on sufficiently long for the internal clot to firmly adhere to the intima, so that it can resist the pressure of the blood; and secondly, the forceps must be very carefully removed so as not to open out the crushed end of the vessel and displace the clot.

Torsion may still be used in dealing with small vessels, but is never practised now in the case of the large arteries. The cut end of the artery is seized cleanly, and gently drawn upon and twisted some eight half turns. The intima and media snap across, and the outer coat curls up in a knob at the end of the vessel. The forceps must not be twisted off, since the curled-up, knob-like external coat is an excellent safeguard against further bleeding. Torsion should never be performed upon visceral arteries nor upon friable arterio-sclerotic vessels.

Angiotripsy.—Doyen is responsible for the introduction of the powerful crushing instruments sometimes used. These not merely crush the blood vessels of the part to which the instrument is applied and so act as hæmostats, but they also reduce large masses of peri-vascular tissue included within their grasp to little more than a thin, frayed-out, ribbon-like layer, to which if necessary a much smaller ligature can be applied than would otherwise have been required. The method has been used in the treatment of large pieces of tissue, such as the broad ligament or the large pedicles of tumours. Under the name of "enterotribe," these instruments have been used in intestinal surgery, the ends of the bowel being crushed in bowel re-sections, and a ligature applied around the crushed ends, which are buried by a purse-string suture, a lateral anastomosis being then effected between the two segments of intestine (*see* Fig. 2). Gray's modification of Doyen's enterotribe has, in the writer's hand, proved a very satisfactory instrument in intestinal work.

Galvano-Cauterisation may be applied after crushing the tissues with the angiotribe; this is called electro-thermic angiotripsy. The writer has had no experience of this method, but it has found advocates. The heat travels beyond the crushed and cauterised area and produces changes in the intima of the vessels, leading to coagulation of blood in the tissues beyond the crushed mass.

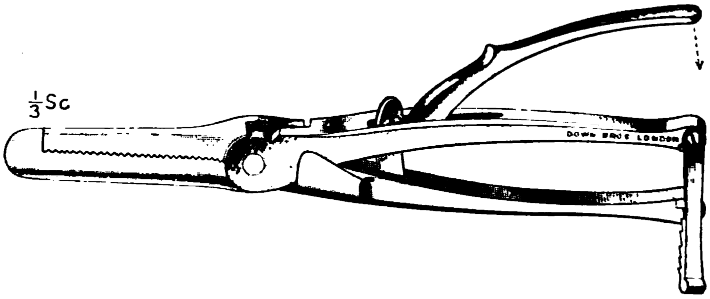


FIG. 2.—H. M. W. Gray's enterotribe.

The Application of a Rubber Tourniquet, whether preceded or not by forcible compression with an elastic bandage, is another method in which the general mechanical principle of pressure is applied in the treatment of hæmorrhage. The tourniquet may be used as a means both of arresting and preventing hæmorrhage; as a contrivance for arresting hæmorrhage, substitutes for the rubber tourniquet may be made of handkerchiefs, braces, belts, pieces of rope and such-like articles. A handkerchief is taken and a knot is tied in the middle and placed over the artery to be compressed; the handkerchief is next carried round the limb and tied once, and then a stick is placed against the knot and tied in. The stick is twisted round and round until the whole limb is compressed, and with it the artery. The stick should not be twisted further when it is seen that the hæmorrhage has ceased, and should then be fixed by tying a second bandage or piece of string around it and the limb. At the end of half-an-hour such a tourniquet should be slackened by untwisting, and if the bleeding does not re-commence it may be left slack, but should not be removed entirely.

In general operative work the Esmarch's tourniquet is the most popular; the writer prefers Maw's "Securitas" tourniquet, which is a modification of the Esmarch and of Foulis's tourniquet, and consists of two metal hooks, which work by a hinge movement on a short metal tube, and a thick piece of thick-walled rubber tubing. When in use both ends of the rubber tubing are on the stretch, and so there is equal tension throughout. The rubber band being made in a tubular form becomes flattened when in use, and does not therefore cut into the skin in the same manner as one made of solid cord. This tourniquet is infinitely preferable to such an instrument as Petit's, which always seems to slip or get out of order.

It is, of course, quite useless applying such a tourniquet over the forearm or leg, since the two bones in these regions must protect the inter-osseous vessels from pressure, and so hæmostasis would be incomplete. The tourniquet should therefore be applied around the humerus or femur, and at such a part that no vessel can escape the pressure. If a bandage is used as a tourniquet, repeated constriction at the same level should be avoided, especially in the thin type of patient, since the underlying vessels and nerves may be permanently injured; thus each turn of the rubber should be separated by an intervening space. The constricted limb must not be suddenly or violently flexed or extended after the tourniquet is in position, otherwise the underlying vessels and nerves may be torn subcutaneously. As regards the duration of the time the tourniquet may be allowed to remain in place without damaging the tissues, this will vary with the constitutional condition of the patient; but even in the healthy it must be borne in mind that after the first hour every minute is likely to add to the risk of permanent injury to the limb from prolonged ischæmia. The danger consists in actual gangrene of the distal parts, contracture and rigidity.

Compression with an Esmarch's Bandage as a preliminary to the application of the tourniquet has been practised most frequently in connection with the limbs, with the idea of emptying the latter of blood as much as possible, but the practice has been justly criticised on the following grounds: firstly, there is a very distinct risk of embolism occurring in cases where the application is being performed for some infective condition of the part, and, again, in cases of malignant disease there is a danger of the cancerous particles being forced into the venous and lymphatic circulation and carried to distant parts as metastatic nodules. Excessive capillary oozing may result, requiring an undue number of ligatures and an increased expenditure of time over the operation.

Cold acts as a hæmostatic agent by causing contraction of the muscular coats of the blood vessels, and is more effectual in arterial than in venous hæmorrhage. Ice may be given to suck in case of hæmorrhage from the mouth and throat; irrigation of the mouth with iced water may be useful in cases of hæmorrhage in inoperable cancer of the tongue, and an ice-bag applied to the surface of the body will also influence the amount of hæmorrhage taking place in the parts situated more deeply beneath the site of the cold application. It is well known to most that very often the mere opening up of a wound and its exposure to the air may suffice to arrest the bleeding which had been kept up by the natural warmth of the body. Cold evaporating lotions are sometimes of value in the case of contusions and other injuries associated with effusion of blood. It must, however, be borne in mind that cold has a depressing effect upon the circulation, and that prolonged application of cold to a part, especially in the aged, may actually lead to sloughing of the injured area.

Heat is a very valuable hæmostatic agent, and may be used in a number of different ways: thus it may be applied in the form of the cautery, hot water, hot towels, hot dabs, the galvano-cautery or steam. The use in cases of uterine hæmorrhage after labour of irrigation with hot boiled water, at a temperature of about 118° F., that is to say, at a temperature which, though uncomfortably warm, is just not too hot to permit the hand being held in it, is a familiar instance of the value of hot water for hæmostatic purposes. The employment of hot towels during a breast operation not only keeps the part warm, and thus prevents shock and chest complications, but also checks the oozing from the large exposed surface. *The cautery* is a most important hæmostatic, and should be used at a black or a dull red heat, for if bright red it is not hæmostatic, but cuts like a knife. The common form in general surgical work is the Paquelin cautery, and it is especially useful in the treatment of hæmorrhage in infected wounds with sloughing surfaces where a ligature will not hold, or in places where a ligature cannot readily be applied: thus the writer has seen it succeed in cases of bleeding after tonsillectomy, when other measures have failed. It is also still used as a means of treating internal hæmorrhoids, and is a most excellent method. In using the cautery it must be remembered that several seconds are required for the closure of the artery, depending upon the size of the vessel; a very firm occlusion of the vessel results, and the slough is an aseptic one.

Styptics are chemical agents which arrest hæmorrhage by causing contraction of the vessels and albuminous coagulation. Styptics, however, are very liable to fail, for the stream of blood may wash them away from the bleeding point, and thus, if they are to be used to the best advantage, the surface must be carefully dried before the application be made. One of the best-known astringents is *adrenalin*, which is used in a solution of 1 in 1,000, and applied to the bleeding point or surface upon a piece of sterilised wool or gauze; the hæmostasis resulting may sometimes be only temporary, and may be followed by vascular dilatation. It is, however, very useful in operations upon the nose and throat, and may also be employed to prevent bleeding taking place into large tuberculous abscess cavities, which have been opened or aspirated.

Powdered alum, tannin and gallic acid are also useful astringents, and the writer has found *pulv. ferri sulph. exsiccatus of the B.P.* useful in cases of bleeding in inoperable malignant disease of the tongue; *witch hazel, infusion of matico,* or *tinctura ferri perchlor.* may also be used. But apart from drugs, which exert their effect locally, medicaments may also be exhibited, which either alter the coagulability of the blood, or so influence the general condition of the patient as to favour hæmostasis. In cases of severe internal hæmorrhage where there is no possibility of surgical interference, or where, for the present, surgical measures are not entertained, *morphia* may be a most valuable drug, and should be given hypodermically. It acts by inducing quiet and abolishing that restlessness which is commonly associated with severe bleeding, and which serves to stimulate the heart and vasomotor centre, and to thus keep the blood-pressure raised. Dixon has shown that such drugs as adrenalin, ergot, barium salts, tannin and the like are all worse than useless for internal hæmorrhage, since they raise the blood-pressure.

Calcium chloride or calcium lactate is an excellent drug for increasing the coagulability of the blood, and is more useful as a provisional hæmostatic agent; for example, it may be given in doses of 20 gr. up to the amount of 3 drachms in the twenty-four hours preceding operation in the case of a jaundiced patient, and in several cases of prostatectomy the operation has become absolutely bloodless.

Gelatine also increases the coagulability of the blood, and may be given in the form of jellies to patients who have suffered from internal hæmorrhage, where no surgical treatment is available.

Immobility or Complete Rest is another very important means of aiding hæmostasis, both as a method of checking hæmorrhage, when the bleeding point cannot be directly attacked by surgical measures, and as a means of guarding against reactionary or intermediary hæmorrhage, whether internal or external.

Position is also an important general measure for checking hæmorrhage. In cases of severe hæmorrhage the patient is usually found lying horizontally, the syncopal attack being nature's means of ultimately bringing more blood to the anæmic brain and medulla, and thus stimulating to activity the cardiac and vasomotor centres to maintain the flagging circulation. But if the patient is not found in this position, it may be well to place him in a recumbent posture, or even to facilitate the flow of blood to the brain by raising the pelvis and limbs, lowering the head, and, if necessary, supplementing this treatment by bandaging the legs and arms: indeed, one, two, or all of the limbs can be excluded from the circulation by bandaging, and even subsequently applying a tourniquet at their roots for a sufficient time to permit of more active and permanent measures being taken.

Position, too, may be utilised, not only for purposes of treating the grave constitutional effects of hæmorrhage, but as a means of anticipating and preventing the loss of blood which attends certain operations, and of thus minimising the shock entailed by this. The Trendelenburg position is useful, not only because of the access to the pelvis which it affords, but also because of the diminished bleeding which it causes. Elevation of the head and trunk in cranial, facial and mouth operations greatly diminishes both arterial and venous hæmorrhage, and it is specially useful in operations upon the brain and upon the Gasserian ganglion. Elevation of the patient's head and shoulders may be useful in checking oozing following the operation of gastro-jejunostomy, and the treatment of a bleeding varicose vein is familiar to everyone.

Elevation of the limb may be supplemented by forced flexion in the treatment of hæmorrhage: thus the leg should be flexed at the knee, and the thigh acutely flexed on the pelvis in cases of hæmorrhage from the vessels of the leg or foot.

Saline Infusion.—This is the best constitutional method of treating the effects of hæmorrhage in common use. It has been found that the grave effects of serious hæmorrhage are largely due to the empty condition of the vessels, whereby the blood-pressure falls to such a point that the circulation can only with great difficulty be maintained, or indeed may entirely fail. The most ready means of combating this circulatory collapse is to replace the fluid which has been lost from the vascular system by some bland inert fluid, and thus to raise the blood-pressure. The fluid most commonly employed is so-called normal saline solution, which consists of 1 drachm of sodium chloride to 1 pint of sterilised water. The dry crystals of common salt are dissolved in a small quantity of boiling water so as to sterilise them, and this solution is then diluted to the required bulk and strength. It is often convenient to keep saline solution in stock ready for cases of emergency, and it is then customarily stocked in a solution of double strength, which is diluted with an equal quantity of boiling water to bring it to the proper temperature when it is required for actual use. Soloids of sodium chloride can also be obtained of such a strength that the addition of one to 1 pint of boiling water makes a saline solution of normal strength. During the operation of infusion the temperature at which the saline is kept in the container is about 105° to 110°, but some surgeons recommend a temperature of 120°, arguing that the warmer fluid is very stimulating to the heart and to the muscular coats of the vessels, and thus aids in raising the blood-pressure.

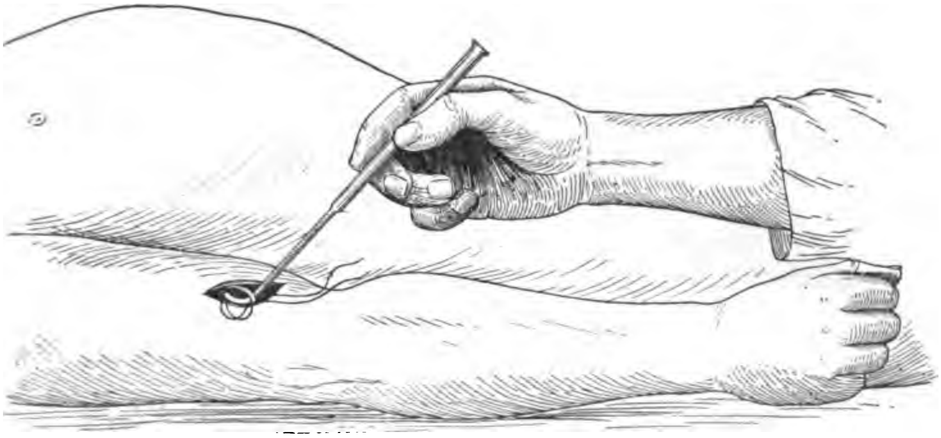


FIG. 3.—Oblique incision to expose median cephalic vein. Aneuryism needle with thread passed under vein.

In cases of hæmorrhage the saline may be run into the subcutaneous tissues, into the rectum, either intermittently or continuously, into the peritoneal cavity or into a vein, and when the need of fluid for the circulatory system is urgent the intra-venous route is the most rapidly effective, and is the one most generally employed. The vessel usually selected is one of the superficial veins in the region of the elbow, either the median basilic or the median cephalic, and the surgeon will find that the application of a bandage tied around the upper arm at a higher level may help him to more rapidly find the vein, sometimes a difficult matter in an already exsanguinated patient or in a very fat individual; the bandage, of course, will be subsequently removed as soon as the cannula is placed in position in the vessel.

The special instruments required for ***intra-venous infusion*** are a glass or metal container, 2 or 3 feet of india-rubber tubing and a cannula, which may be of glass or plated; these must all be sterilised by boiling before being used. In addition to these a scalpel, dissecting forceps, aneurysm needle and a straight sewing needle, together with a reel of No. 60 thread or No. 2 silk, will be required. Comyns Berkeley's infusion set is a very convenient one, as it is small and readily packed, and it is well to have such an apparatus always in the operating bag.

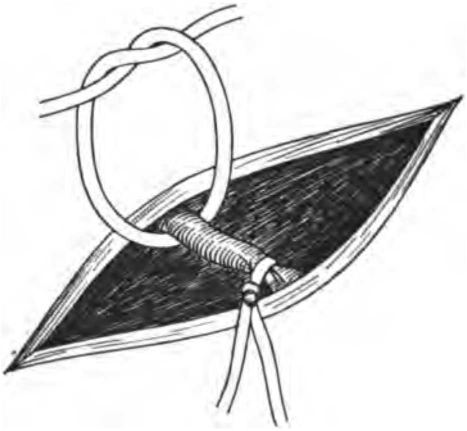


FIG. 4.—Distal ligature tied in reef-knot; proximal ligature loosely knotted.

Having ascertained that the saline is ready in the container at the required temperature, the skin is rapidly sterilised by painting with tincture of iodine, and a transverse or oblique incision made in the region of the elbow over the selected vein, the latter is exposed, and an aneurysm needle armed with a double thread is passed under the vein, care being taken not to include any branches of the internal cutaneous nerve in the needle if the median basilic is selected (Fig. 3). The loop of thread is cut, and the two strands are then manipulated along the vessel to each end of the segment of vein exposed. The distal ligature having been tied in a reef knot, the proximal strand is loosely knotted, and left lying out of the upper end of the incision (Fig. 4). The vein is then drawn upon by means of the distal ligature, and opened on the cardiac side of the latter by means of an oblique snip with a pair of scissors, producing a V-shaped incision into the vein, the base of the V upward (Fig. 5 and Fig. 6); it will be found that the lumen of the vessel is more easily opened up in this way than with the point of a knife. The cannula, from which some saline is first allowed to flow away so as to expel any air which may have been present in the rubber tubing (Fig. 7), is now manipulated into the vein, and the proximal loop of thread, the ends of which had been but loosely interlocked, is now tied once round the vein and cannula with sufficient firmness to keep the latter in place (Fig. 8); the ends of this thread will, of course, be tied a second time when the cannula is withdrawn at the end of the operation.

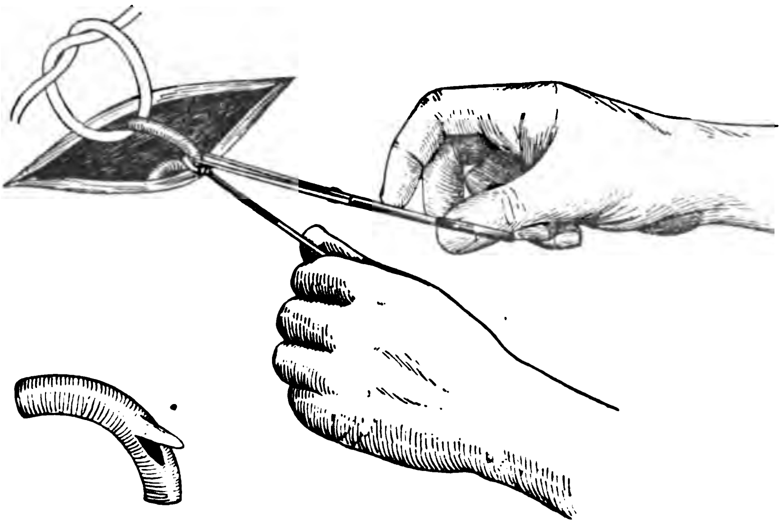


FIG. 5 and FIG. 6.—Traction on vein by distal ligature; snipping vein with scissors; V-shaped incision in vein thus produced.

As regards the amount of saline which should be administered, the quantity should be determined by the effects produced: thus 30 to 40 oz. will often suffice in a case of acute hæmorrhagic collapse to restore the pulse to its normal volume and frequency, and the greater the quantity of fluid required to restore this the graver will be the prognosis. In administering large quantities of saline it must be borne in mind that the function of the heart-muscle is already impaired owing to the loss of blood and the deficient circulation through the coronary vessels, and if the amount of fluid in the vascular system is too suddenly increased, the heart may become acutely dilated, and cardiac paralysis and death will result. It is important that the fluid should not be allowed to run into the vascular system too quickly, and it should not, therefore, be introduced at a faster rate than 1 pint in ten minutes. Matas points out that it is important to watch the condition of the peripheral veins, "since it is from the venous side that the first warning of impeded circulation comes."

If a repetition of the infusion is deemed likely at the completion of the operation, the cannula may be left *in situ*, or the proximal ligature may be tied, and the ends purposely left long may be brought outside the skin wound to facilitate the identification of the vessel another time. Lazarus-Barlow has shown that one of the conditions to be combated, alike in conditions of shock and after severe hæmorrhage, is an alteration in the specific gravity of the blood and tissues, in addition to the modification of the blood pressure which results from severe bleeding, and he has experimentally shown that a single infusion of moderate size so commonly practised, although apparently temporarily beneficial, is yet really worse than useless, since it aggravates the condition which it purports to rectify. He, therefore, recommends that the infusion should be repeated time after time, or that it should be continued for some hours. Clinical experience teaches the writer that large infusions into the veins are not only borne badly but are dangerous,

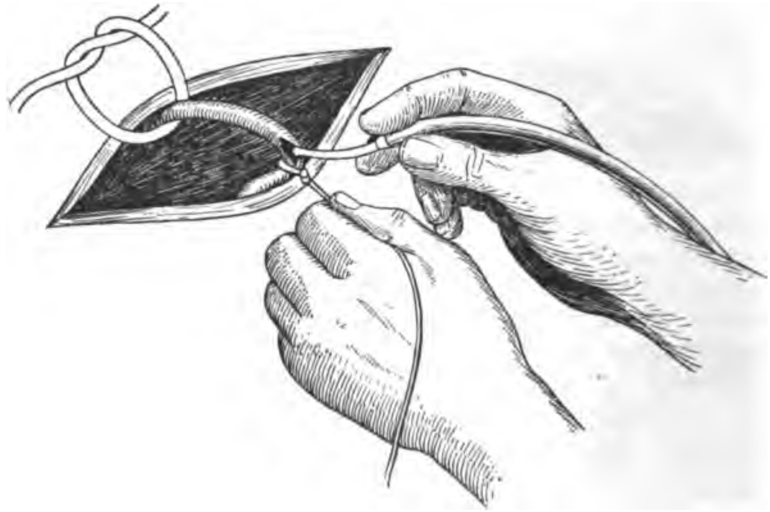


FIG. 7.—Introduction of cannula into vein.

as remarked above; frequent infusions of small amount may be very valuable, and should certainly be preferred.

Various fluids have been used for intra-venous infusion, normal saline (*vide supra*) being that most frequently used. Lazarus-Barlow, on experimental grounds, recommends a *glucose solution* as being better borne in animal experiments and leading to smaller changes in the blood corpuscles than solutions of common salt. Further, there is an advantage in giving glucose in that it is a food for the tissues. If glucose is used, it should be given in a 2¼ per cent. solution, and in cases of emergency glucose may be replaced by cane sugar: thus three large lumps of white sugar to 1 pint of water would form a solution of approximately the proper strength.

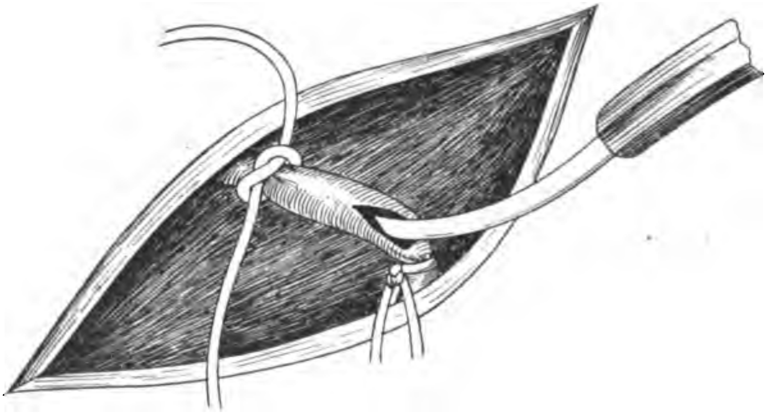


FIG. 8.—Cannula fixed in position by tightly tying proximal loop of thread once.

Oxygen has also been added to the saline: the solution is saturated with the gas before introduction into the vein, and it is said to be especially valuable in grave hæmorrhages. The writer has had no experience of this method.

Other veins may, of course, be utilised for intra-venous infusion in addition to those of the elbow; for example, the internal saphenous vein is very convenient, or the veins on the dorsum of the foot.

Hypodermoclysis, or the injection of saline under the skin, is not so rapidly effective as intra-venous infusion, but use is frequently made of this method during the course of surgical operations, in order to minimise surgical shock, and the method is also valuable in the treatment of infective conditions such as diffuse peritonitis, as well as in cases of hæmorrhage. The saline is most conveniently given into the tissues of the axilla, the thigh, the flank, or under the breast. The simplest mode of administration is by an ordinary infusion container, which is connected by rubber tubing with a sharp, aspirating needle, preferably one with several apertures. After the usual disinfection of the skin the needle is plunged into the subcutaneous tissues, and the fluid allowed to run in. About 1 pint can be run in under each breast, and the needle then removed and the opening sealed with a little sterile gauze and collodion.

Continuous hypodermoclysis may be practised, but this is more frequently utilised in diffuse septic conditions than in cases of hæmorrhage. If this be done, the container should be suspended to the bed-rail above the bed, and connected by a T-shaped junction with two cannulæ, so that the fluid may be run into each thigh or flank; in this way large quantities of fluid may be administered. The means of keeping the solution in the container warm will be considered under Enteroclysis.

Intra-peritoneal administration of saline may be utilised, not only in the treatment of shock following prolonged abdominal operations, but also in the treatment of hæmorrhage, especially intra-abdominal hæmorrhage; it is, therefore, valuable in cases of ruptured extra-uterine gestation, traumatic abdominal hæmorrhages, and particularly of reactionary hæmorrhage when laparotomy has been performed, and the bleeding point or area identified and controlled. In cases where the abdominal wall is closed in layers, when the last sutures in the peritoneum have been inserted, but not tightened or tied, a glass funnel carefully sterilised is introduced into the peritoneal cavity, and the saline poured in from a jug or similar vessel at a temperature of about 105°. If the abdominal walls are closed by through-and-through sutures, a slight modification of the procedure will, of course, be necessary. About 2 or 3 pints of saline should be introduced, and, by slightly tilting the patient, it will be found that less of the fluid makes its escape. The method may be practised either as a substitute for, or as an adjunct to, intra-venous infusion; but it must certainly not be employed in septic abdominal conditions, because of the risk of spreading infection to parts of the peritoneal cavity which have been hitherto sterile.

Enteroclysis, or the administration of saline into the bowel, is very familiar as a routine performance in the after-treatment of serious surgical cases, especially of abdominal operations, but when severe hæmorrhage has taken place, this method is not so rapidly effected as the intra-venous. Rectal infusions of fluid, however, can be given as a means of treating cases where hæmorrhage has been of a less severe character, and also as an adjunct to intra-venous infusion when much blood has been lost. In cases where hæmorrhage is expected in a surgical undertaking, it is good practice to administer ½ pint or 1 pint of saline by the rectum before the operation.

Saline may be given by the rectum, either intermittently or continuously. The former is the more usual procedure, and the first quantity injected is commonly 10 oz. The injection, if necessary, may be repeated every two hours, but it will be found that the quantity which the bowel will tolerate subsequently does not amount to more than 6 oz., so that the later injections should not exceed this amount; if there is less urgency, then the saline may be given every four hours. The apparatus required for the rectal administration of saline consists of a glass funnel attached to a No. 12 soft catheter, and a jug, or some such receptacle, to hold the fluid, which should be given at a temperature of about 100°. The catheter is introduced into the bowel, and the saline allowed to run in slowly.

In cases of continuous rectal infusion, a container is required for the fluid and some 3 or 4 feet of rubber tubing, to which may be attached a catheter for actual introduction into the rectum, although some have recommended a pewter nozzle, which may be suitably bent. The fluid should be kept at a temperature of about 108° to allow for the cooling which will take place during its passage along the tube. The container should only be about 5 or 6 inches above the height of the buttocks, otherwise the fluid will run in too fast and will not be retained. To keep the fluid at a constant temperature, the simplest device is to place an ordinary electric hand-lamp against the container, or to surround the latter with rubber hot bottles. More elaborate pieces of apparatus are, of course, obtainable, such as Hird's or Paterson's, but the above device will prove quite satisfactory, if the services of a special nurse can be requisitioned to attend to it. The usual rate of administration is about 1 to 1½ pints in the hour, and large quantities of fluid can be introduced in this way. The method, however, is more valuable and more extensively employed in cases of diffuse peritonitis than of hæmorrhage.

Direct Transfusion of Blood.—This is not a new operation, but formerly its difficulties in the shape of the formation of clots, either in the vessels themselves or in the syringe or cannulæ intervening between the vessels of the donor and the donee, leading to a cessation of the blood flow, and fraught with the risk of embolism, led to the abandonment of the method in favour of infusions with saline, glucose solution, or some such fluid. Recently, thanks to improved technique in vascular suture, direct transfusion has been revised, and some excellent results have been recorded, particularly in America, and it is claimed that the results surpass those due to infusion with other fluids. The good results may be due, not only to the " mere quantitative reinforcement of the blood, but also to the stimulating effect of the transfused blood upon the blood-forming organs, especially the bone marrow." This method, however, has many limitations : firstly, it implies a skilled acquaintance with vascular suture; and secondly, if there is a lack of affinity between the blood of a donor and a donee, hæmolysis will result, and it has been stated that in 40 per cent. or 50 per cent. the bloods are incompatible. To determine the question of affinity means the expenditure of several hours, and many of the cases cannot obviously wait such a length of time. Again, the question of tuberculosis and syphilis must be carefully considered.

Matas states that patients who have been reduced to such a poor condition by repeated hæmorrhages that any serious operation cannot be contemplated may be so revived by direct transfusion of blood that operative measures may be approached with confidence. Transfusion has also been used with success in cases of gas poisoning, hæmorrhagic typhoid fever, certain cases of gastric hæmorrhage, purpura and other conditions. The writer has had no experience of transfusion, and gratefully acknowledges here the information which he has received from the article of Rudolf Matas in Keen's " System of Surgery."

THE VARIETIES OF SURGICAL HÆMORRHAGE.

Surgical hæmorrhage may demand treatment as (1) primary hæmorrhage, (2) reactionary or intermediary hæmorrhage, and (3) secondary hæmorrhage. By primary hæmorrhage is understood the bleeding which occurs as the direct and immediate result of an injury or surgical operation. As Sir Alfred Pearce Gould points out, where disease opens up a vessel, the conditions from the first are those of secondary hæmorrhage.

In the case of **primary hæmorrhage of arterial origin**, there are certain cardinal rules to follow: (1) If the hæmorrhage has been arrested by natural means, there should be no interference, and the operator should be very careful not to roughly handle or manipulate the part, lest he displace the clots which have occluded the wounded vessels. But there are certain exceptions to this rule: (*a*) If an artery is divided in a wound, the distal end should be sought for and tied, even if it is not actually bleeding at the time, because as soon as the collateral circulation is established in full force, reactionary bleeding will take place. (*b*) In the case of punctured wounds of an artery, the vessel should be ligated above and below the puncture, and then divided between. Should suitable material and the necessary instruments be at hand, such an artery may be sutured if the operator has had practice in this department of surgical work. (*c*) When a vessel can be seen obviously pulsating in the wound, although not actually bleeding at the time, and if the patient can ill afford to lose more blood, it should certainly be ligatured.

(2) The second cardinal rule in cases of primary arterial hæmorrhage is to tie the artery at the injured spot, and not to ligature at a more proximal point the vessel from which the bleeding is supposed to be occurring. There are several reasons for this rule, since until the wound is actually opened up and explored, it may be quite impossible to be certain from what vessel the bleeding is taking place, and hence the treatment may not avail the patient at all. Further, in the case of a wound of a large regional artery, if it is ligated in continuity higher up, it is quite possible that gangrene may occur, since there will thus be a double obstacle to the blood flow to the distal parts of the extremity; and, again, if some large branch opens out of the artery between the point of ligature and the wounded spot, reactionary hæmorrhage is almost certain to occur when the collateral circulation is established. But this exception is made, that if the regional artery is one, ligature of which may lead to gangrene or some serious disturbance in the peripheral circulation, then the wound in the vessel should preferably be sutured.

Venous Hæmorrhage.—The arrest of venous hæmorrhage is more readily effected by nature's methods, and hence, as a rule, calls for less energetic surgical measures than arterial bleeding. Usually it will be found that only the distal end of a completely divided vein bleeds; but the large veins, which are influenced by the aspiration of the chest, especially those in the dangerous area at the root of the neck, all varicose veins, and all veins devoid of valves on the cardiac side of the wound, may bleed from the proximal or cardiac side. As in the case of arterial wounds, the best and most reliable means of controlling venous hæmorrhage is the ligature, and ligatures can be applied to veins with far fewer misgivings as to the effect on the distal circulation than in the case of the corresponding arteries.

Punctured wounds of veins may be treated with lateral ligature, or by means of suture, if the materials are at hand. Small veins usually cease to bleed spontaneously, or may be readily arrested by pressure with forceps or packing. In the case of venous hæmorrhage from a part where a ligature cannot be applied, a forceps or clamp can be left on and removed after some hours, when the hæmorrhage will be found to have ceased, and since the pressure in the veins is so low, there is much less risk of any clot being subsequently displaced.

Capillary hæmorrhage is readily arrested by opening up the wound and exposing it to the air, or by the application of heat, pressure, or styptics, such as adrenalin.

Parenchymatous Hæmorrhage. — Parenchymatous hæmorrhage, or bleeding from a very vascular tissue, may be difficult to arrest. Such may be met with in the case of injuries or wounds of the lung, liver, kidneys, erectile tissues, and other parts, and possibly the best method of controlling it is pressure applied by means of a mattress suture, or a series of such sutures, which coapt the two sides of the wound from which bleeding is taking place. This method is very useful in controlling the serious hæmorrhage which sometimes follows an exploratory incision into the renal parenchyma, and it is also useful in checking hæmorrhage from a wound or tear of the liver. In addition to the mattress stitch, accurate coaptation of the edges of the wound by means of interrupted sutures may serve to arrest bleeding.

Heat, either in the form of a hot fluid, hot dab, or the actual cautery, is another valuable method, and packing with gauze, especially iodoform gauze, is a very reliable measure for checking diffuse parenchymatous bleeding.

Reactionary Hæmorrhage.—The treatment of reactionary or intermediary hæmorrhage should, of course, be prophylactic, and a thorough appreciation of the principles of treatment laid down in the section dealing with primary hæmorrhage, together with a careful technique, will make the condition a rare one. Reactionary hæmorrhage is due to some interference with the temporary closure of a vessel or vessels, and ensues within the first twenty-four hours of the operation or injury, before the processes which lead to permanent cicatrisation of the vessel are at all advanced. The principles of treatment of reactionary hæmorrhage are identical with those of primary hæmorrhage, and therefore the wound must be opened up and the bleeding point or surface efficiently dealt with.

Secondary Hæmorrhage—Secondary hæmorrhage is bleeding which results from failure in the repair of an injured or ligatured vessel, or from ulceration into a vessel. There are two main conditions under which secondary hæmorrhage may occur—firstly, when the lumen of the vessel is opened up by ulceration of its walls; and secondly, when the pressure of the blood within it ruptures a healing artery before a strong resisting scar has been formed: both these conditions may be present together. In these days of improved aseptic technique secondary hæmorrhage has become a very rare event.

As soon as it is evident that secondary hæmorrhage has occurred, vigorous effort must be made to deal with it. No matter whether the bleeding has ceased when the case is seen, it is but a herald of what is to follow; hence the wound must be explored, all blood clot evacuated, and careful inspection made to ascertain the origin of the hæmorrhage. The wound may be rubbed or washed out with warm lotion to try and promote the flow of blood, and thus to ascertain the exact site of the bleeding vessel. In the case of an artery divided in the wound, or in an amputation stump, the vessel should be carefully isolated from surrounding structures and ligatured with some thread or silk, care being taken not to tie with sufficient tightness to rupture the two inner tunics and so weaken the vessel. Should the hæmorrhage have occurred from an artery ligatured in continuity or from an artery which has been ulcerated into from without, the vessel must be ligatured above and below the leak as far as possible from the surface of the wound.

Having secured the vessel by ligature, the greatest care must be taken to try and render the part aseptic, since, if this condition is not attained, there is a risk of the hæmorrhage recurring. Pure carbolic acid should therefore be applied to the vessel and the neighbouring tissues, and the wound may be packed with antiseptic gauze after irrigation with a solution of creolin (1 drachm to 1 pint) or the use of hydrogen peroxide.

The patient must be kept absolutely still to keep the blood pressure low, so that there shall be no displacement of clot and no opening up of the ligated vessel. Morphia may be given if necessary, and the patient must be kept under careful supervision, and watch kept for the slightest sign of bleeding. There are, however, certain conditions in which these cases of secondary hæmorrhage cannot be treated by ligature. Thus it may be found that all the tissues in the wound are too friable and sloughy for a ligature to hold, and in such it would probably be the best practice to apply the Paquelin cautery at a dull red heat, not only to the vessel but also to the structures around. It has the advantage that in addition to searing the end of the vessel it produces also an aseptic slough.

Again, in some sloughy and suppurating wounds, the hæmorrhage is diffuse and parenchymatous, and does not come from any one vessel; in these the cautery is the best method of treatment, and subsequent packing with gauze soaked in a solution of creolin or sanitas.

In cases of malignant ulceration in the mouth, pharynx, tongue or other region where ulceration takes place into the vessel, it is impossible to apply satisfactorily a ligature to the bleeding point. In these cases it is questionable whether very active measures are justified, particularly if such involve pain. Probably irrigations with iced-water, tincture of hamamelis, or a solution of adrenalin, together with an injection of morphia hypodermically, represent the extent to which surgical treatment should be pushed.

If, even after vigorous antiseptic measures have been adopted and the artery ligatured, bleeding recommences, the main trunk may be exposed by a fresh incision higher up its course and then ligatured in continuity, but the risk of gangrene in the case of the lower limb is so great that probably the best treatment is amputation.

Special Hæmorrhages.—Wounds of Special Vessels.—In view of the very great loss of blood, or even fatal hæmorrhage, which may ensue from injuries of the main vessels, it may be well to make brief mention of the treatment of certain of these special hæmorrhages : this, of course, is simply the special application of the general principles of treatment of wounded vessels to the individual arteries and veins.

In cases of wounds of the *common, external, or internal carotids*, the hæmorrhage, if not immediately fatal, may be controlled either by digital pressure in the wound itself or by pressure over the common carotid on the cardiac side of the wound: this may be compressed by standing behind the patient and placing the terminal phalanx of the thumb about 1½ inches above the sterno-clavicular joint and pressing backwards and inwards against the transverse process of the sixth cervical vertebra. This compression must be maintained till means are at hand for securing permanent hæmostasis either by double ligature of the wounded artery or by arterial suture. If the bleeding comes from some inaccessible branch of the external carotid, for example, the internal maxillary, the external carotid of the same side may be tied, and if the bleeding recurs its fellow of the opposite side may also be similarly treated. On no account must the common carotid be tied for an injury to a branch of the external carotid.

In the case of hæmorrhage *from the scalp or face*, the bleeding is usually easily controlled by a properly applied suture, and no attempt should be made to ligature the individual vessel of the scalp ; the suture should be made to underrun the bleeding vessel as well as to coapt the edges of the wound. If suture material is not at hand, firm pressure with packing on the wound and the application of a bandage will suffice to arrest the bleeding.

Hæmorrhage from the socket of a tooth after dental extraction should be treated by washing away all clots from the socket and carefully examining to see whether all the tooth has been removed, and the socket should then be packed with sterile wool soaked in adrenalin until the pad rises above the level of the adjacent teeth ; the patient is then instructed to bite firmly on the pad. This bleeding is especially liable to occur in hæmophilics and in those suffering from jaundice, leukæmia, or other blood disease, and may even prove fatal. In such cases it will be well to administer calcium chloride or calcium lactate for a day or two before the dental extraction.

Bleeding from the *palatine arteries* may be controlled by ordinary measures ; but should these fail, it may become necessary to plug the posterior palatine canal with a piece of sterilised wood or an ivory peg.

Bleeding from the *middle meningeal artery*, if coming from the bone, where the vessel lies in a groove or tunnel, is best controlled by plugging the canal with aseptic wax, or with the point of a probe which is heated in a spirit flame.

Hæmorrhage from the *subclavian artery* is very serious, and its treatment and that of its branches calls for the application of ordinary surgical measures. Compression of the artery may be called for to control severe hæmorrhage from the arm or during amputation of the upper limb, and is applied by compressing the vessel against the first rib with the terminal phalanx of the thumb of the operator. Hæmorrhage from the *vertebral artery* may be controlled by opening up the wound, and, if possible, securing the vessel with a double ligature, or by tightly packing it with aseptic gauze.

The *brachial artery* may be compressed against the inner side of the humerus, the surgeon standing behind the patient and passing his hand, palm upward, under the arm of the patient between the latter and the chest. Pressure is then made with the fingers over the line of the vessel along the inner bi-cipital furrow. This may be necessary in the case of amputations, or to control bleeding coming from wounds of the forearm or hand.

Wounds of the palmar arteries should be treated on the ordinary surgical principle of securing the bleeding points themselves, and this may require careful enlargement of the wound, and the temporary application of pressure above in the form of a tourniquet. The position of the wound may give the surgeon some idea as to which arch has been injured: thus the superficial arch may be said roughly to lie on the same level as the outstretched thumb, while the deep arch is about ½ inch higher up; further, pressure on the ulnar artery is more likely to control hæmorrhage from the superficial arch, whereas if the deep arch is wounded, the bleeding is more likely to be controlled by radial pressure, but accurate information can only be obtained by careful exploration. The wound should be enlarged upwards and downwards in a vertical direction in order to avoid tendons or nerves, the clot then turned out, and, if possible, the bleeding points ligatured. If this is impracticable and the hæmorrhage is of deep-arch origin, the radial artery may be tied just at the point where it becomes the palmar arch, after detaching the inner head of the first dorsal inter-osseous muscle. Should this fail, firm packing of the wound should be tried, and the fist clenched and kept fixed by the application of a firm bandage. Other more heroic measures may sometimes require adoption.

Injuries to the gluteal and sciatic arteries are treated on ordinary surgical lines, but occasionally it may be justifiable to compress or tie the internal iliac artery. In injuries of the *femoral artery* or its branches the usual rules must be followed. If the *femoral artery* requires compression, this should be made against the brim of the pelvis.

Hæmorrhage from a varicose vein, whether due to a wound or caused by bursting under strain, or by ulceration, may be very severe, if the patient continues in the erect position with the leg hanging down. If, however, the patient well raises the leg, the hæmorrhage is most easily arrested, and a pad can be fixed over the wounded spot and kept in position by a bandage turned around the foot and leg from the toes upwards.

Gastro-intestinal post-operative hæmorrhage is met with most frequently in septic cases, but may also occur in apparently non-septic conditions. The early hæmorrhages are, of course, of the same nature as reactionary bleeding, and must be treated accordingly; but there are other hæmorrhages which come on three or four days after operation, and are due to thrombosis of the large vessels of the mesentery or omentum, with secondary ulceration in the stomach or bowel. The treatment of these cases is limited to the application of adrenalin or some other styptic solution. In septic cases every effort must be made adequately to drain the infected spot, if this has not already been done; but the outlook is bad, since the infection has evidently become generalised. Anti-toxic sera have been given with but little effect, and normal horse-serum has also been tried. Possibly direct blood transfusion may lead to better results.

GORDON TAYLOR.

WOUNDS OF ARTERIES.

Wounds of arteries may be considered under the following headings: (1) Subcutaneous injuries; (2) incised wounds; (3) punctured wounds.

Subcutaneous Injuries of Arteries.—If a contusion over an artery is quickly followed by ischæmia and pallor of the peripheral parts and a loss of pulsation in the vessel at and below the point struck, *thrombotic obstruction* is to be diagnosed, and the treatment should be directed to maintain the vitality of the part rendered anæmic. Absolute rest, therefore, must be enjoined to prevent the possibility of any embolic obstruction of the distal parts; the extremity should be carefully sterilised and wrapped up in cyanide gauze and aseptic wool and kept warm, but hot bottles must not be applied next the skin for fear of gangrene in parts already devitalised. Great care must be taken that no constriction or pressure is applied to any part of the limb above, at, or below the contused spot, and if these details are carefully attended to, the local anæmia may be more or less completely recovered from. The prognosis will depend upon: (1) The severity and extent of the injury; (2) the extent to which the collateral circulation can be opened up—this, of course, will vary with the general condition of the arteries of the patient; (3) the associated injury to bone, nerve, and such-like structures; and (4) the particular region which has been subjected to traumatism, Matas stating that the probability of gangrene is five times as great in injuries of the lower as in those of the upper extremity.

If a rapidly *increasing diffused hæmatoma* develops as a result of a severe contusion, *immediate operative measures* must be undertaken. The main artery must be temporarily compressed above the site of the injury, while preparations are being made to deal with the vessel at the bleeding spot; thus temporary hæmostasis may be effected by means of an ordinary Esmarch's tourniquet at the root of the limb, or if that is impracticable, as in the case of the femoral, axillary and carotid vessels, compression must be maintained by digital pressure to the vessel on the cardiac side of the lesion, or the vessel may be controlled by means of angular traction with a loop of silk or thread passed in an aneurysm needle round the main artery higher up its course, the vessel being approached through a separate incision. Thus in the case of a ruptured axillary artery, whether due to a mechanical injury to the arm, or due to efforts at reducing an old dislocation of the shoulder, it will be good surgical treatment to cut down upon the third part of the subclavian artery, and thus control it before opening up the axilla to deal with the bleeding axillary vessels. The circulation being under control, a free incision must then be made down over the swelling, the blood clot must be turned out and search made for the opening in the artery; the latter can then be ligatured above and below the injured spot. It has been recommended before applying the ligature to explore the vessel above and below the wound for clot; these blood clots may extend some little distance above and below the point of rupture of the vessel, and may thus occlude the orifices of important vessels, and thus the risk of peripheral gangrene may be increased. Such exploration may be effected by means of a ureteral catheter well lubricated with sterile vaseline. The prognosis is always very bad in the case of contused wounds of the lower limb, more especially in the popliteal region, and when the vein is coincidently damaged, gangrene being then exceeding liable to result. Therefore it would probably be best to operate as soon as ever it is apparent that the vessel has been ruptured; all clots should be turned out, and the artery and vein should then each be ligatured above and below the injured spot after the lumen has been explored for thrombi, and if the patient is young and his vessels in good condition it is just possible that a collateral circulation may be established.

If the operator has had practice in *arterial suture*, and if the necessary material and needle are at hand, then modern experience would appear to teach that suture of the vessels holds out most hope; thus if each vessel is in fair condition and there is only a lateral rent, the clot should be cleared out from the lumen and the vessel gently sponged with warm saline, and a lateral suture performed for both artery and vein. If either artery or vein is so lacerated that lateral suture will not suffice, the vessel should be divided, the ends freshened, and an end-to-end suture performed. If a vessel is so extensively damaged that a re-section of the artery is required exceeding ¾ inch, then a so-called by-terminal arteriovenous anastomosis may be done, the proximal and distal ends of the artery being connected by means of a segment of vein; for example, the saphenous vein might be used to connect the two parts of a divided popliteal artery.

In the case of the lower limb in elderly persons, probably the best course will be immediate amputation, since gangrene is otherwise certain to ensue, and this may be performed under stovaine anæsthesia, together with a short general anæsthetic of gas and oxygen to prevent, or at any rate to minimise, any further shock. The prognosis in the case of the upper extremity, even in the elderly, is distinctly better than in the lower limb, and at any rate in an injury below the middle of the arm the establishment of an adequate collateral circulation may be confidently expected; higher up than this level the outlook is more serious.

If dry gangrene has already occurred, amputation should be performed after the line of demarcation has formed, and in cases of moist gangrene amputation should be performed at the level of the obstruction as soon as ever the patient's condition will permit of this being done.

If a localised pulsating hæmatoma develops, the artery should at once be controlled above the site of the swelling, and the latter should be cut down upon and the blood clot evacuated, and the vessel dealt with either by double ligature or by suture, according to the rules laid down under the heading of Diffuse Blood Extravasation.

Lacerated Wounds.—Lacerated wounds are attended with but little hæmorrhage, the brittle inner tube-coats quickly snapping across and curling up within the vessel, and a clot forming upon them. The adventitia stretched beyond the limits of its elasticity breaks across, and the frayed end falls over the end of the vessel. If a lacerated artery has ceased to bleed it should not be interfered with, but an endeavour should be made to maintain asepsis of the part. If the artery is bleeding ligation should be done.

The treatment of Incised and Punctured Wounds is considered under the treatment of Surgical Hæmorrhage.

GORDON TAYLOR.

BLOOD PRESSURE.

HIGH BLOOD PRESSURE.

In order to estimate the degree of the pressure which the blood is exercising on the walls of the arteries it is necessary to use an instrument. To attempt such estimation by the mere fingering of the radial pulse is to adopt a procedure which, even in the hands of the most experienced, is utterly fallacious. There are numerous very reliable instruments on the market; the two best suited for the consulting-room are Oliver's alcoholic instrument and C. J. Martin's modification of Riva-Rocci's mercurial instrument, both of which are sold by Messrs. Hawksley, of 357, Oxford Street. A convenient instrument for the pocket, which is sufficiently accurate for ordinary purposes, is Leonard Hill's manometer.

The two former are very easy to manage, but before the records of the latter can be trusted a certain amount of practice on the part of the examiner is necessary. The normal blood pressure may be taken as 120 millimètres Hg. Such would be the case in a healthy adult male from eighteen to thirty-five years of age. In women it is perhaps slightly less; in children definitely less, *i.e.*, about 100 millimètres Hg. After middle age the pressure tends to rise progressively. Thus, at fifty it may, without harm, be 150 millimètres Hg; at sixty it may be 160 millimètres Hg; but under no circumstances can a sustained pressure of over 160 millimètres Hg be regarded as free from danger. The figures here quoted refer to the systolic pressure; the methods of estimating the diastolic pressure have so far proved of no value.

The blood pressure is very readily increased by transitory causes. Mental excitement, pain, a full meal, constipation, are amongst the most common. These, especially the first, must be excluded before deciding that a high reading is abnormal. It is only sustained hypertension which demands treatment. Nervous people, especially such as are unacquainted with methods of blood pressure estimation, frequently show high readings on a first examination which subsequently prove to have been due to excitement.

"High blood pressure," "high arterial tension," "hypertension," are terms used synonymously to indicate a condition in which the pressure is definitely and persistently above the normal for the person's age. Such a state of matters is a common accompaniment of certain chronic diseases, such as granular or interstitial nephritis and generalised arterio-sclerosis, and of some acute conditions, such as puerperal eclampsia, but it may also be present when the patient is in seeming health and has nothing more definite to complain of than a slight headache, some insomnia or a general feeling of malaise, and in whom physical examination seems to reveal nothing of importance until the manometer comes to be employed. Such a state of functional hypertension, if allowed to go unchecked, will in the long run lead to disease in the arteries, and may at any moment provoke a hæmorrhage in almost any situation. The nose, the internal capsule, the fundus oculi, the lungs, the stomach, the kidneys, are all of them points of predilection. In the presence of a complaint, or rather the admission (for it is seldom complained of) of breathlessness on slight exertion; of the discovery on auscultation of a definitely accentuated second sound at the aortic cartilage, or of the fact that the urine has a specific gravity of 1,015 or less, it is the duty of the physician to conduct a very careful examination into the state of the blood pressure, and if it is found to be unduly elevated, immediately to take steps to reduce it.

When the blood pressure is persistently at a high level it is liable to be raised temporarily to a much higher point by such causes as have already been mentioned, in which case there will arise various symptoms which are less transient than the causes which produce them. Chief among these are headache and giddiness. It should, however, be remembered that, as a general rule, blood pressures of moderately high elevation, even though they be progressive, not only occasion no symptoms at all, but inasmuch as they are stimulating, are rather agreeable to the patient.

The Treatment of a Case of Hypertension depends in a measure upon the cause, but from the danger which it threatens to the integrity of the blood-vessels in important parts the hypertension itself may demand immediate treatment. For this purpose the inhalation of nitrite of amyl is extremely useful. The drug can be obtained in small glass capsules, covered with cotton-wool and silk, each containing 5 min. The capsule is broken across and the escaping liquid is immediately inhaled through the nostrils. The peripheral arteries quickly dilate and the blood pressure falls. It is advisable to place the patient in a recumbent or semi-recumbent posture before the inhalation, because the rapidity with which the arteries dilate may, so to speak, take the heart at a disadvantage and give rise to a feeling of faintness. If such a result should occur the head should immediately be lowered, the foot-end of the bed elevated, and gentle though firm pressure exercised on the abdomen so as to empty the splanchnic vessels towards the heart. It is, however, exceedingly rare for any such measures to be called for, the only effect of the inhalation being usually one of considerable relief. Patients who are the subjects of persistent irremediable hypertension of high degree, such as those suffering from chronic interstitial nephritis, may be given these capsules to carry about with them. Less prompt in affording relief, but slightly more durable in the relief which it affords, is nitro-glycerine. Perhaps the most convenient form for its administration are the tabloids called "trinitrin" of Messrs. Burroughs, Wellcome & Co., which are made in three strengths, *i.e.*, $\frac{1}{200}$ gr., $\frac{1}{100}$ gr. and $\frac{1}{50}$ gr. The tabloid of $\frac{1}{100}$ gr. is the most generally useful. For the relief of urgent symptoms two tabloids of this strength should be rapidly chewed and swallowed, and for the purpose of warding off the attacks one tabloid may be taken every three or four hours.

To procure relief which is rapid, and much more durable than would on theoretical grounds be supposed to be possible, by far the best measure is *venesection* up to 30 oz.

Even where time is not the essence of successful treatment, venesection is probably the best expedient for reducing blood pressure, and, in obstinate cases, it may with advantage be performed every six months. The mode of life is important. The diet should be supervised, more perhaps in the matter of quantity than in that of quality, though it is well to restrict flesh-foods to the mid-day meal, and to enjoin abstinence from, or very strict moderation in, alcoholic drinks. The intake of common salt should be limited if possible to 150 gr. a day. Exercise in the open-air for an hour a day at the very least must be insisted upon, but the patient is to be severely cautioned against vigorous exercise, and more especially against sudden violent exertion, such as running to catch a train. Violent exertion contracts the arteries, whereas gentle exercise, such as walking, gradually dilates them. Warm baths, *i.e.*, 100° to 102° F., of a duration of not more than twenty minutes, may be taken every night. Turkish baths may be substituted with advantage, but should not be taken more often than three times a week. General massage every evening before retiring is a most useful measure. Great attention should be paid to the bowels. Mercury in the form either of blue pill or calomel should be given at least once a week. Calomel (2 gr.) and blue pill (3 gr.) forms a useful combination to be given on Saturday night, followed by a saline on Sunday morning. On the other days in the week 2 gr. of cascara extract may be alternated with 20 gr. of pulv. jalap co., or a full dose of some natural mineral water, such as Arabella, which may be said to be practically free from common salt. A course of treatment at a suitable health resort is invaluable in purely functional cases. Evian, on the Lake of Geneva (season from May to September), is the best reputed and most generally to be trusted, though Vichy, Aix-les-Bains, and Buxton may be well suited to particular cases. In so far as drugs are concerned, there are none except those which have already been mentioned which have any real influence in bringing about a permanent lowering of persistent high pressure, but the following mixture, when combined with the other measures above described, will often prove useful: ℞. Sodii Iodid., gr. 6; Sodii Nitrit., gr. 1; Aq. Chlorof., ad ℥ss; M. Sig. ter. die [U.S.P. ℞. Sodii Iodid., gr. 6; Sodii Nitrit., gr. 1; Aq. Chlorof., ʒij; Aquam ad ℥ss]. Whitla ("Dictionary of Treatment") advocates frequent doses of small quantities ($\frac{1}{1000}$ gr.) of nitro-glycerine, an expedient which many physicians have found very helpful. Sir Lauder Brunton directs his patients to bite off little bits of the tabloid of $\frac{1}{100}$ gr. above alluded to, several times a day. The same authority recommends the following: ℞. Potass. Nitratis, gr. 20; Sodii Nitritis, gr. 1 to 2; ft. pulv. To be dissolved in a glassful of water and taken once daily. If there is constipation, Karlsbad salts (2 drachms) may be added to the mixture.

For the permanent residence of those with chronic irremediable high blood pressure, a sedative equable climate should be selected. Amongst seaside resorts, Llandudno, in North Wales, and the Devonshire south coast stations, such as Sidmouth, Exmouth and Torquay, are good examples. Inland, the two best stations are Cheltenham and Bath.

LOW BLOOD PRESSURE.

When the blood pressure falls to the point at which the medulla ceases to be adequately supplied with blood the patient dies. This is seen as a terminal event in what is known as surgical shock or collapse. Inasmuch as the essence of the condition is medullary exhaustion, it is bad practice to employ drugs, such as strychnine, which stimulate the medulla. The best drugs to exhibit are those which stimulate the cardio-vascular musculature otherwise than by the medullary route. Such are ergot, eserine and pituitary extract, which will presently be referred to in detail. Minor degrees of low blood pressure, or hypotension, though not dangerous to life, are very unpleasant to the patient, who is always depressed and becomes very exhausted on the slightest exertion. Such patients are frequently labelled hysterical or neurasthenic. Most convalescents from acute diseases are hypotensive, and women at the menopause are frequently so.

The manometric reading which represents unduly low blood pressure is to some extent an individual matter, but again taking the figures above mentioned as the standard for a healthy person, if the blood pressure ought to be 120 millimètres Hg, and the manometer does not show a higher reading than 90 millimètres Hg, and so on, in proportion, the degree of hypotension present is such as to call urgently for treatment.

The Treatment of Low Blood Pressure consists in general hygienic measures, the exhibition of vaso-constrictor drugs, and the selection of a suitable climate. Of the first, particular care should be exercised in the matter of clothing, which should be light. Flannel should not be worn next the skin, because it dilates the cutaneous vessels. Porous linen or cotton underwear should be insisted upon. Cold sponge baths (50° to 60° F.) should be taken daily and followed by such exercises as tend to develop the abdominal muscles. The foot-end of the bed should be raised on blocks and the number of bedclothes carefully limited to what is really necessary. Of drugs the most effectual is the extract of pituitary gland. This may be given by the mouth in Burroughs, Wellcome's tabloids. One tabloid of 2 gr. may be given four times daily by the mouth, and the dose increased if necessary. Pituitary extract has no toxic or cumulative effects, but the blood pressure must be kept under observation. Occasionally oral administration is ineffectual, in which case the drug must be given by intramuscular injection, for which purpose the "vaporoles" made by the same firm are very suitable. Of the fluid contained in the "vaporoles," 1 cubic centimètre should be injected twice a day; the effects being carefully watched. Eserine is a very useful drug, especially in urgent cases. Although occasionally very effective when given by the mouth in doses of $\frac{1}{50}$ gr., it is perhaps best administered by subcutaneous injection in doses of $\frac{1}{50}$ to $\frac{1}{100}$ gr.

The liquid extract of ergot administered in doses of from 20 to 30 min. every four hours is very useful in cases where its selective effect upon the uterus need not be considered. It may be combined with small doses (1 to 2 min.) of tincture of digitalis, but unless there is very good reason to incriminate the heart in the production of the hypotension, cardiac tonics are as a rule better omitted. If their use seems to be indicated, the dosage should be very small. A bracing climate is of great assistance in the treatment of most cases. Margate and the other resorts on the Isle of Thanet have a special value in this connection. Of inland places those of moderately high altitude are the most generally useful, such as Ilkley, Buxton and Church Stretton, in this country, and Caux and Territet, in Switzerland.

LEONARD WILLIAMS.

ARTERIO-SCLEROSIS.

Arterio-sclerosis is a morbid change which takes place insidiously in the arterial tree and results in an undue rigidity of the vessels, which lose their elasticity and become tough and tortuous. The arteries, through diminished elasticity, cease to exert that constant pressure on their contents so essential to an efficient circulation and, owing to an alteration in the lumen of the smaller vessels, the blood flows with increasing difficulty, a combination which results in a defective blood supply to the vital organs. This hampering of the circulation is a most serious thing for the well-being of the patient, striking as it does at the nutrition of the tissues and the functional activity of all the important viscera.

Clinically, at least two large groups are recognised, the nodal and the diffuse: (1) Where disease of the vessel wall is discrete and nodular, including both endarteritis obliterans and atheroma. (2) Arterio-capillary fibrosis, a diffuse widespread change in the vessels of all grades which is associated with important morbid processes in the viscera.

This visceral involvement is so prominent a feature that Huchard has suggested the term "arterio-visceral-sclerosis." The factors initiating the focal and nodular degeneration are many, and the actual changes in the vessel wall are not in any true sense comparable with true arterio-capillary fibrosis. In the nodular type the viscera escape unless the lumen of a vessel is seriously encroached upón or actually occluded by the localised disease, and the blood pressure is only raised when either diffuse peripheral sclerosis or chronic nephritis are present as a complication of the localised degenerative changes. Both endarteritis obliterans and true atheroma are subdivisions of the nodular group. True atheroma affects principally the aorta and the cerebral and coronary vessels, and is essentially a disease of those in advanced years. Endarteritis obliterans, on the other hand, is found at any age; its occurrence and its localisation depend entirely on the presence of a causal toxin, such as syphilis or tubercle, or disease localised outside the vessel wall.

Clinically, the nodular and the diffuse forms of arterial disease must be differentiated, for they differ in their etiology, in their symptomatology, and in their treatment.

Arterio-capillary fibrosis is a disease of the capillaries and the smaller vessels. The walls of the smaller arteries become thicker, the muscular coat is hypertrophied, and the intima shows hyperplastic thickening. This thickening of the endothelial lining extends even to the capillaries. The peripheral vessels become more palpable to the finger and may be visible at the wrist, at the bend of the elbow, and in the temporal region, where they are seen to be tortüous and moving with each pulse.

One cannot, however, form a true estimate of the extent of the generalised disease by an examination of the peripheral vessels. The sclerotic changes in the radial and temporal arteries may be very slight and yet there may be ample evidence of advanced arterio-sclerosis in other areas. This relative focussing of the arterio-sclerosis changes is of very great clinical importance, because as its consequence the early symptoms may indicate disease of one or other viscus and the underlying generalised vascular defect may be overlooked. The treatment in such cases must obviously be directed not only to the relief of the damaged organ, but also to the improvement of the whole arterial vascular tissue.

The viscera which most commonly give evidence of this focussing are the kidneys and the heart. Arterio-sclerotic changes in the mesenteric vessels may give rise to troublesome crises of abdominal pain and flatulence, and degenerative changes in the cerebral vessels are often the cause of well-recognised symptoms.

The two factors which appear to be of the greatest importance in the production of arterio-sclerosis are: (1) Raised blood pressure; (2) an inherited defective vascular tissue, and in such patients a normal blood pressure is sufficient to inaugurate degenerative changes, even in the absence of any other etiological factor. Clinically, it is found that the increase of blood pressure is either temporary or permanent and is associated with hypertrophy of the heart.

It must be clearly borne in mind, however, that the arterial hypertension is not the result of increased cardiac activity. The heart is large, partly in response to the extra work which is demanded from it in its struggle against the raised blood pressure, and also in other instances owing to pathological changes present in the myocardium, consequent on arterio-sclerosis of the coronary vessels, the so-called "cardiac dystrophic hypertrophy." A later stage in the progress of these patients is that of cardiac failure, when the left ventricle becomes unable to cope with the persistent hypertension. This cardiac inability is precipitated and accentuated by the defective flow of blood through the diseased coronaries.

The treatment of generalised arterio-sclerosis to be effective must be commenced at a very early stage, and is based very largely on a clear conception of the etiological factors present in each particular case. Whatever produces high blood pressure may be looked upon as inimical to the health of the blood-vessels and contrary to the best interests of the tissues.

One of the commonest causes of hypertension is undoubtedly chronic nephritis. The second in importance is over-eating and over-drinking, the quantity of the fluid consumed being an important factor. An excessive use of alcohol is generally held responsible for an acceleration and accentuation of existing arterial disease even if it does not actually initiate the condition. Hepatic or pancreatic inadequacy and gastro-intestinal disturbance may all give rise to toxins, which, when absorbed, cause paroxysmal or persistent contraction of the peripheral vessels and consequent hypertension.

Intestinal fermentation or putrefaction are probably the most important. In recent years the use of tobacco has been viewed with increasing suspicion. Some authorities hold that it is a most potent factor in the causation of vascular disease. Various other intoxications may seriously damage the vessel walls, such as lead, mercury, and the bacterial toxins of typhoid fever, rheumatism and syphilis. The intermittent stress to which the vessels are subject during excessive physical exertion is detrimental to the health of the vessels.

The treatment of a patient will depend upon the stage of the disease at which he presents himself, and upon the salient symptoms which are distressing him. It is important to remember that renal or cardiac inadequacy may be the earliest indications of the widespread vascular degeneration, and in such cases the hæmodynamometer gives valuable assistance.

Clinically, hypertension signifies, except in a few unusual cases, either renal disease or arterio-sclerosis; it must never be forgotten that hypertension is a symptom resulting from abnormal conditions, and that it is these conditions rather than the increasing tension which have to be attacked.

The actual thickening of the vessels in marked arterio-sclerosis is obviously beyond treatment, and the efforts of the physician at this stage must be directed to the amelioration of symptoms and attempts to prevent extension of the disease. Earlier, however, much can be done by careful regulation of the mode of life in all its details, based upon a full appreciation of the detrimental factors peculiar to each case. In families in which vascular degeneration is common, measures should be taken long before there are any indications of changes in the vessels, and a careful outlook should be kept for any symptom pointing to commencing arterio-sclerosis of the viscera. It is not infrequently difficult to obtain the co-operation of the patient, for in the early stage with raised blood pressure there may be a feeling of well-being, which appears to the patient to justify him in following his own inclination, rather than his doctor's orders.

Especial care should be observed during the convalescence from febrile complaints, and more particularly after influenza. During the acute process the toxins still further damage the myocardium and the heart is rendered less able to meet even the ordinary calls which are made upon it, to which in these patients is added the continuous strain of hypertension. Accordingly, after influenza and similar complaints, it is wise to prolong the period of confinement to bed and to keep the patient on a bland diet, chiefly milk.

The broad principles on which treatment must be based are as follows: (1) To prevent the absorption of toxins from the gastro-intestinal tract; (2) to aid the elimination of toxins; (3) to relieve undue spasm of the vessels; (4) to prevent sudden changes of blood pressure; (5) to treat cardiac failure and the symptoms of cardiac stress we must first direct our attention to the gastro-intestinal tract.

GENERAL TREATMENT.

Alimentary wrong-doing is the most important factor to be considered in treatment. The diet must be dealt with in every detail, and almost invariably requires to be cut down. Over-eating is the common fault. The food must be simple, not highly flavoured, and should be well cooked and thoroughly masticated. For the latter purpose efficient teeth are necessary. Generally the number of the meals can be reduced with advantage, and it is found that much less is eaten when fluids are not permitted to be taken with the food.

When there is evidence of considerable gastro-intestinal disturbance the patient must be put on a pure milk diet for some weeks, and this can be repeated at intervals with advantage. This diet is of considerable value during the periods of hypertension; the patient should be kept at rest in bed and receive between 3 to 5 pints of milk a day, for a period of two or three weeks. Rich foods, meat soups, beef-tea, Bovril and other foods containing extractives are bad and to be avoided.

Flesh meat of all kinds should be indulged in sparingly, and should be boiled rather than roasted, for by boiling many of the extractives are removed.

The diet should tend to be lacto-vegetarian. What is needed is plain, nourishing, simple food, moderate in quantity and easy of digestion.

Exercise is of considerable importance, for arterio-sclerosis is not uncommonly found in those who are corpulent and live a sedentary life. This habit of body is often associated with a tendency to physical indolence, a tendency which must be vigorously counteracted. The value of early rising should be impressed upon such patients and strictly enforced. Exercise regulates the blood pressure, assists the skin, and improves the tone and nutrition of the muscles. Regulated exercises, such as those described by Müller in his "System," are valuable and helpful. Exercise should always be taken in the open-air when possible. Walking, horse-riding or bicycling are to be recommended, provided the rider keeps well within his power, and does not, in the excitement of the run, attempt too much; an occasional swim or a game of golf may be advised.

Easy hill climbing is one of the best forms of exercise; the rule to be observed is to slacken the pace when the breathing becomes short, and not to climb above moderate altitudes. Altitudes of over 2,000 feet are injurious and may cause distress, especially when there is cardio-sclerosis. Distressing palpitation and dyspnœa may be brought on by even a short stay at such altitudes. Sudden or severe muscular effort is dangerous, and may be followed by disastrous consequences. These are more likely to result when hypertension is associated with advanced patchy degeneration of the vessels and where the heart is bearing the burden of moderate stress with difficulty.

The hygiene of the skin must not be neglected; for the vigorous, a daily tub in tepid water, a good rub down, and an occasional warm bath will help its free action. The elderly and the feeble must be satisfied with a tepid sponge and firm friction with a towel. The circulation of arterio-sclerotic patients is defective, their limbs are often cold and liable to cramps; therefore, it is important that they should be warmly clad, and not expose themselves recklessly to cold winds or damp. A mild equable climate suits them best.

Spa Treatment.—For those who can afford a month or six weeks at a spa, where they can carry out the *régime* of early rising, restricted diet, moderate exercise and hydrotherapy, it is to be advised, but such treatment should only be undertaken when supervised by a local practitioner.

In regulating the habits etiological indications are of great importance. Hereditary tendencies to gout, obesity or vascular disease must be noted and counteracted.

It is wise to ascertain the patient's daily allowance of *alcohol*, and when practicable to advise complete abstinence. In many cases this—the counsel of perfection—is refused, and it is then best to make a compromise and to allow a small quantity of whisky and water at night.

Tobacco must also come under the ban, for the less it is used the better for the patient.

Medicinal Treatment.—The aim of medicinal treatment is to secure a healthy action of the gastro-intestinal tract, to counteract any abnormal conditions of the liver or pancreas, and to aid the kidneys and the skin in their excretory functions. By such means we can diminish the production of toxins and facilitate their removal.

In many instances it is found necessary to control the hypertension directly, and more especially is this advisable during the hypertensive crises which at times supervene. It is not possible to dissociate the treatment of pure arterio-sclerosis from the associated cardio-sclerosis; such an attempt would be both irrational and unsatisfactory. While the patient is under observation records of the blood pressure should be taken regularly, and at the beginning and as a preliminary to treatment the effect of nitro-glycerine or the nitrites on the hypertension should be estimated. The degree of response to the vaso-dilator is some indication of the extent to which the hypertension is the result of spasm and hypertonus of the arterial wall.

Among the many drugs which are employed in the treatment of this condition, *mercury* is undoubtedly the most valuable; it not only acts as an excellent purgative, but also as an intestinal antiseptic and a valuable cholagogue. It is well to follow it up and complement its action with a saline morning draught, such as a Seidlitz powder, or 2 drachms of sulphate or phosphate of soda in water; the combined action of the mercury and the saline should be of sufficient strength to produce one or two free watery evacuations.

The mercury can be given as the blue pill (5 gr.), or a combination of blue pill (4 gr.) and rhubarb pill (3 gr.), once or twice a week. If once a week only, then Saturday night is often a convenient time.

Calomel in doses of ⅙ grain thrice daily, or ¼ grain twice a day for periods of a week at a time, is sometimes equally effective, or ¼ grain may be given every night for longer periods. Whatever method be chosen for the administration of the mercury the saline should be taken regularly every morning; even a suspicion of constipation should not be tolerated. Hepatic stimulants, such as iridin and podophyllin, are useful in the form of an after-dinner pill.

By such a course of treatment the blood pressure is controlled, and there is generally marked improvement in the comfort of the patient.

In the *iodine preparations* we have another valuable group of remedies, though there is some difference of opinion as to the stage at which they should be administered and their mode of action. Huchard believes that they are inadvisable in the first or pre-sclerotic period, and he relies entirely on dieting, diuretics, such drugs as the theobromine preparations, with massage, exercises, baths and so forth. These methods, together with the exhibition of mercury, salines and cholagogues, as described above, are ample. As a matter of fact, it is the rule, rather than the exception, for the patients to present appreciable signs of arterial thickening when they first come under observation, and there need then be no hesitation in utilising iodine and the iodides. The salts of potassium and sodium are most commonly used in doses of 5 or 10 grains thrice daily. If iodism or severe depression result from 5 grains thrice daily the dose should be doubled, for the larger quantity is often tolerated with comfort. A useful mode of prescribing the iodide is in combination with potassium citrate: ℞. Potassii Iodidi, gr. 5; Potassii Citratis, gr. 30; Aq., ad ʒj; or ℞. Potassii Iodidi, gr. 7; Tinct. Nucis. Vom., ♏5; Liq. Arsenicalis, ♏2; Aq., ad ʒj [U.S.P. ℞. Potassii Iodidi, gr. 7; Tinct. Nucis Vom., ♏12; Liq. Potassii Arsenitis, ♏2; Aq., ad ʒj]. Other iodine preparations in common use are the tincture in 3 minim doses with glycerine and the syrup of iodine and tannic acid (Syrupus Iodo-Tannicus (Martindale) Ed. 1910) in ½ or 1 drachm doses thrice daily. This latter is a rather objectionable though useful combination. Iodipin in ½ to 1 drachm doses or iodoglidine in tablets are pleasant forms of administration, and frequently tolerated when the salts of potassium and sodium give rise to toxic symptoms. When it is considered advisable to reduce hypertension, either because it is persistently excessive and causing subjective symptoms, or on account of a sudden increase in the pressure, the *nitrites* may be employed as complementary to the therapeutic methods already described. At first they must be used tentatively and the effect of the initial dose on the blood pressure carefully noted; $\frac{1}{100}$ grains of nitro-glycerine, or 3 grains of sodium nitrite, may be given. If the blood pressure is unaffected and there are no disquieting symptoms the dose should be repeated in an hour and the result watched. There is generally a distinct drop in the pressure and an amelioration of the subjective symptoms: sometimes, however—and this must be remembered—the patient collapses and is greatly distressed. Fortunately this rarely happens.

If the arterial degeneration is advanced and the hypertension the outcome of arterial destruction, rather than vasomotor spasm, the nitrites are of little service, and the tentative dose will not appreciably diminish the tension. Patients suffering from Bright's disease with high grades of blood pressure do not, as a rule, benefit from nitrite therapy.

The vaso-dilators most commonly used are the nitrite of sodium, liquor trinitrini, and erythrol-tetranitrate. The nitrite is less active than the others, and is well suited for routine administration. It is wise to begin with small doses, such as ½ grain, repeated every four hours, and the quantity can be increased gradually until relief is obtained. Some patients can tolerate large doses with comfort. The official tabellæ trinitrini may be divided, and one-half sucked every two hours.

Lauder Brunton advises the following method of administration: ℞. Sod. Nitritis, gr. 1 vel gr. 2; Pot. Nitratis, Pot. Bicarb., āā gr. 10; to be taken in hot water as a draught thrice daily after meals or every morning on rising.

According to Oliver, both the *hippurate and benzoate of ammonium* act as apressor remedies, and can be combined in 10-grain doses for prolonged administration; he also suggests that the following mixture be ordered to replace common table salt: Ammonium Hippurate, 1 part; Potassium Nitrate, 4 parts; Potassium Chloride, 25 parts. This may be of service when it is desirable to eliminate common table salt from the diet. Moderate relief of hypertension is frequently obtained by the exhibition of drachm doses of nitrous spirits of ether taken three or four times daily. The nitrites, when employed too vigorously, sometimes lead to the appearance of œdema and hydrothorax, and when this occurs it must be taken as an indication for a diminution of the dose.

Œdema and Hydrothorax may also point to cardiac failure, and is then accompanied by dyspnœa on slight exertion, increased pulse frequency, and other signs of myocardial inefficiency. There may be in addition a definite drop in the blood pressure. Digitalis, strophanthus or squills should be administered in tentative doses, and the theobromine group is also valuable as a direct cardiac stimulant. Diuretin or theocine sodium acetate (4 to 7 grains) thrice daily should be ordered either with or without digitalis.

The best results from the administration of digitalis are obtained in those patients in whom the myocardium has largely escaped sclerotic changes, and where it has failed to maintain its struggle against the hypertension with a consequent serious drop in the blood pressure. Impaired tonicity of the heart muscle must, when possible, be corrected by the digitalis group, and the blood pressure maintained at whatever point is most compatible with cardiovascular efficiency.

Mackenzie has pointed out the value of *chloral hydrate* in the insomnia and nocturnal dyspnœa of patients suffering from arterio-cardio-sclerosis, and this drug may be given with safety in doses of from 10 to 20 grains at night. If it fails, then opium or some other hypnotic must be prescribed, due consideration being paid to the presence of cyanosis and the condition of the lungs. It is extremely important that these patients should have undisturbed nights.

The cardiac irregularity which is such a frequent accompaniment of arterio-sclerosis is sometimes most distressing; dieting, attention to habits of life and personal hygiene, with treatment of any gastro-intestinal abnormality, is often all that is required, but if the irregular action persists and proves annoying a combination of dilute hydrobromic acid (15 min.) or ammonium bromide (15 gr.), with nux vomica, is often of service: ℞. Acidi Hydrobromici Dil., ♏15; Liq. Strychninæ Hydrochlor., ♏8; Aq. Chloroform., ad ℥j [U.S.P. ℞. Acidi Hydrobromici Dil., ♏15; Strychninæ Hydrochlor., gr. $\frac{1}{36}$; Aq. Chloroformi, ℥ss; Aquam, ad ℥j].

A method of "regularising" the blood pressure has been described by Raoul Blondel,[1] of Paris. He gives hypodermic injections of lacto-serum; this serum has the property of reducing hypertension. The method of administration is to inject 10 cubic centimètres daily until the blood pressure has become normal, then to give an injection every week for a month, and finally, one injection every three months.

The blood pressure can certainly be modified by this serum, and anginal pains and other indications of hypertension relieved, but very distressing symptoms occasionally manifest themselves after injection, and great care must be taken when employing this treatment.

JOHN HAY.

REFERENCE.

[1] Lancet, 1909, I., p. 1038

SURGICAL ASPECTS OF ARTERIO-SCLEROSIS.

To this common disease of the arterial system no specific surgical measures can be applied, but the condition, nevertheless, concerns surgical treatment in a two-fold manner: firstly, the constitutional effects of the arterio-sclerotic process very greatly modify the results of surgical procedures; and secondly, surgery may be required to deal with some of the local manifestations of this widespread disease. Individuals whose tissues are in a condition of impoverished nutrition will naturally prove less suitable subjects for any surgical operation; and further, they will fare much worse than those whose arteries are more healthy if they happen to suffer any accidental injury. Wounds heal much less kindly, tissues are much more liable to slough, shock is much more pronounced, and the risks of a general anæsthetic are much greater than in those whose arterial tree is sound. The risk of a cerebral hæmorrhage as the result of the excitement and struggling under general anæsthesia would seem to call for a spinal anæsthetic in some of these cases.

When gangrene actually begins gradually, as it does in the last stages of arterio-sclerosis, in the most distal parts, *e.g.*, the toes, the question of amputation must be considered, and the course usually followed is to wait until a line of demarcation has formed, unless a simultaneous ascending thrombosis of the artery occurs, leading to rapidly progressive gangrene; then immediate amputation must be resorted to, and the operation is usually performed above the knee. In such cases the writer has a preference for Lister's modification of Carden's supra-condyloid amputation. When amputation has been performed, and it is then found that the artery at the point of section is thrombosed and does not bleed, it is said to be sometimes worth while, instead of re-amputation higher up, to clear out the clot by introducing a probe dipped in sterile vaseline into the vessel lumen and so making the vessel bleed. This should be followed by gentle massage towards the periphery.

Arterio-sclerosis also concerns the surgeon in the matter of the application of ligatures, the latter being much more likely to cut rapidly through the brittle vessel wall, and torsion is also impracticable as a method of dealing with the artery, since the damaged vessel snaps across.

GORDON TAYLOR.

THE MEDICAL TREATMENT OF AORTIC ANEURYSM.

THE etiological influence of syphilis in the production of aneurysm furnishes a definite prophylactic indication in regard to the latter. There can be no doubt that the incidence of aneurysm will become increasingly less as the possibility of early and prolonged treatment of all cases of syphilis becomes greater.

The medical treatment of aneurysm may be considered under the headings of measures which aim at producing a cure and measures which aim at the relief of symptoms. It is obvious that cure can only be possible in cases of saccular aneurysm.

MEASURES WHICH AIM AT PRODUCING A CURE.

Aneurysm can only be cured by the obliteration of the sac by layers of laminated blood clot. From time to time certain lines of treatment have been advocated with a view to favouring coagulation in the sac. Historically the oldest is that of Albertini and Valsalva, reported by Morgagni in the latter half of the eighteenth century.

Valsalva recommended that the patient should be kept strictly in bed for forty days, at the same time he was subjected to repeated small venesections (6 or 8 oz.), and the allowance of food and drink was steadily diminished until extreme weakness resulted, when the amount of nourishment was gradually increased again.

The results of this treatment do not appear to have been very successful, and Morgagni himself states that success can only be hoped for in early cases.[1]

In 1852 Dr. Bellingham[2] advocated a modification of Valsalva's treatment, in which venesection was dispensed with. This method was elaborated by Dr. Tufnell,[3] whose name it now bears.

Tufnell's Treatment.—The principles of this treatment are to keep the patient at absolute rest in a horizontal position for three months or longer, and at the same time to restrict the diet so that the patient is taking only 10 oz. of solid and 8 oz. of fluid in the twenty-four hours. By this means it is hoped, as stated by Bellingham: (1) To diminish the distending force of the blood from within (and, above all, to diminish the frequency as much as possible of the heart's beats): (2) to favour the deposition of fibrin on the walls of the sac.: (3) to maintain this process until the sac is filled up and thus obliterated: (4) to bring about these results without deteriorating the quality of the blood or diminishing too much the patient's strength.

Tufnell's diet is arranged as follows: 2 oz. of bread and butter and 2 oz. of milk or cocoa for breakfast; 3 oz. of cooked meat, 3 oz. of bread or potatoes and 4 oz. of water or light claret for dinner; and 2 oz. of bread and butter and 2 oz. of milk or cocoa in the evening.

The discomfort and annoyance attending the adoption of Tufnell's treatment in its entirety are so great that many patients decline to persevere with it; further, even when it is strictly enforced, the resulting benefits are seldom very pronounced. It is, perhaps, most worthy of trial in cases of small saccular aneurysm in young people.[4] The enforced rest is the most valuable part of the treatment, since the frequency of the cardiac pulsations can be reduced from twenty to thirty beats per minute by assuming a horizontal position.

The value of **Potassium Iodide** in cases of aneurysm has been recognised for upwards of a quarter of a century. The action of the drug is three-fold: First, it lowers the blood-pressure and so favours coagulation in the sac; secondly, it undoubtedly relieves pain in many instances; and thirdly, there is its specific action on tertiary syphilitic lesions.

The drug should be prescribed in 10-gr. doses thrice daily; this amount should be rapidly increased until 30 or 40 gr. are being taken at each dose. If the pulse rate becomes accelerated, the dose must be lessened until the maximum amount of iodide is being taken which does not have this effect. The iodide should be administered for five or six weeks, when it may be omitted for a few weeks. In this manner it may be taken for years.

In 1897 Lancéreaux[5] advocated the treatment of aneurysm by the **subcutaneous injection of gelatine.** For this purpose a 2 per cent. solution of gelatine is made in ·7 per cent. saline solution; of this mixture 3 oz. is injected every third day into the flank or buttock until thirty or forty injections have been given. Unhappy results have been recorded owing to the contamination of the gelatine with the tetanus bacillus, but, provided the solution is properly sterilised before use, the method is free from risk. Favourable results have been reported from its use; certainly it is more likely to promote coagulation in the sac than any other means at our disposal.

Whatever special treatment is adopted, it is improbable that any more successful result will be obtained than the prolonging of life for a time. It is, therefore, suggested that the best line of treatment for asymptomatic cases will be found in a combination of the preceding methods, that is to say:

Absolute rest in bed for four or five weeks at least; the patient must lie as flat as possible, and must make no effort for himself; a modified diet, containing but little meat, and an allowance of fluid restricted to 20 oz. a day or less; the more or less continuous administration of potassium iodide, and a course of sub-cutaneous gelatine injection. At the same time mental worry and excitement must be guarded against; alcohol or other stimulant disallowed, and any risk of constipation prevented by the daily administration of a saline aperient.

In view of the unsuccessful results of treatment it is doubtful if it is advisable to persuade to strict treatment a sufferer from aortic aneurysm, who, being cognisant of his malady and its attendant risks, desires to continue his ordinary life till the last possible moment.

Such a person should, however, be advised to avoid fatigue, both mental and bodily, as far as is possible, never to hurry or make sudden efforts, to refrain from dietetic excesses, and to guard against constipation. He should also be treated with potassium iodide.

MEASURES WHICH AIM AT THE RELIEF OF SYMPTOMS.

Rest is often sufficient to remove some of the most distressing symptoms of aneurysm; cough and dyspnœa may disappear in a few days, and extensive areas of collapsed lung may once more become fully aërated.

Venesection, best carried out in repeated small bleedings of 4 to 8 oz., is of value for the relief of venous congestion, paroxysmal dyspnœa and attacks of anginoid pain.

Chloroform inhalations may be necessary to control the graver forms of paroxysmal dyspnœa.

Tracheotomy can very rarely be indicated, for the obstruction is commonly about the bifurcation of the trachea; but, very occasionally, it may be possible to pass a catheter beyond the obstruction *viâ* a tracheotomy wound. Again, should laryngoscopy reveal double abductor paralysis of the vocal cords, tracheotomy would be indicated.

Pain, if neuralgic, is frequently relieved by the administration of potassium iodide, especially in those cases which are of syphilitic origin; aspirin or phenacetin or plasters of belladonna or of opium may be sufficient in milder cases, and amyl nitrite inhalations or repeated small doses of nitro-glycerine ($\frac{1}{500}$ gr. every hour) may relieve anginoid attacks. For persistent pain, and especially for the agonising pains due to irritation of the spinal nerve roots following erosion of the vertebral column, there is no option but to give morphia. It is usually necessary to give increasing doses of this drug; it may have to be pushed until the patient is taking several grains a day.

The discomfort of a tumour pulsating in the chest wall may sometimes be diminished by support and firm pressure from an elastic bandage.

Hæmorrhage from an aneurysm, though commonly fatal in a few minutes, is not necessarily so; patients have been known to live for months or years with recurrent small hæmorrhages, and considerable improvement has taken place after very severe hæmorrhages. If there is a small hæmorrhage or oozing externally from a thoracic aneurysm, a firm bandage should be applied and absolute rest enjoined, while a subcutaneous injection of morphia should be administered. Similarly, complete rest is the only possible treatment for hæmorrhage into the trachea or œsophagus that is not so profuse as to be immediately fatal.

JAMES TORRENS.

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THE SURGICAL TREATMENT OF ANEURYSM.

In the treatment of aneurysm by surgical means the following points must be considered: (1) *The general condition of the vascular system.*—Any marked degeneration of the vessel walls is of importance, since rigidity of the walls may prevent the formation of a satisfactory collateral circulation, and weakness of the walls, on the other hand, may be followed by dilatation of another part of the artery after ligature. Multiple aneurysms or the presence of an intra-thoracic aneurysm are also contra-indications to operative interference. (2) *The position and size of the aneurysm.*—On the anatomical relations and size of the aneurysm depends the question as to whether excision, proximal ligature or distal ligature can be performed. Thus an innominate aneurysm is only amenable to distal ligature; a popliteal aneurysm, if small, may be excised, but, if large, must of necessity be treated by proximal ligature, since the popliteal nerves are likely to be intimately related to the sac wall.

General Treatment.—In all cases a certain amount of preliminary treatment is advisable: the objects to be aimed at are to decrease the force of the heart beat and increase the coagulability of the blood. To decrease the force of the beat absolute rest is essential, with the patient lying as nearly in the horizontal position as possible; pain and restlessness may be relieved by the administration of opium in some form. To increase the coagulability of the blood calcium salts and potassium iodide are useful, while purgation and restriction of the fluid intake are of assistance in reducing the volume of the blood (*see* also Medical Treatment of Aneurysm). Finally, in dealing with large aneurysms, intermittent compression of the artery above the aneurysm for a few days before the operation is often of value, by permitting the deposit of blood clot on the sac wall, and also by partly opening the collateral circulation and so diminishing the risk of gangrene.

Methods of Treatment.—No details of operative treatment will be given; for these the reader is referred to standard text-books on Operative Surgery.

Excision.—Where possible this operation is in all probability the best procedure, and the results appear to be good. The chief risk is of injury to surrounding structures which, if the aneurysm is large, may be incorporated in the sac wall. Excision is also of value when recurrence has occurred after proximal ligature.

Ligature.—(1) *Proximal Ligature.*—This method is applicable to the majority of aneurysms, and is extremely successful. Monod and Vanvert[1] record 74 per cent. of cures in their collected cases. The ligature may be applied close to the sac (Anel's operation) or at some distance from it (the Hunterian operation). The former operation is more difficult to perform in most cases, but it is more likely to succeed; the chief risk is in the possibility of the arterial wall near the aneurysm being diseased. The Hunterian operation is easier to perform, but too free anastomosis may lead to recurrent pulsation requiring further treatment.

(2) *Distal Ligature.*—This method is of value when proximal ligature is impossible for anatomical reasons, *e.g.*, in innominate aneurysm or in an aneurysm of the left carotid artery near its origin. Two operations are possible: Brasdor's, in which the circulation through the sac is completely cut off, and Wardrop's, in which the whole stream of blood through the sac is not entirely stopped, as in ligature of the common carotid and subclavian arteries for innominate aneurysm. This operation is never employed when proximal ligature can be utilised, and the results are not very encouraging.

Compression.—Compression of the arterial trunk above the site of the aneurysm may be effected in the following ways: (1) *Digitally.*—Relays of assistants are required, and there is great tendency for the part to become sore from continual pressure on one spot; this must be guarded against by the use of dusting powders locally, and by slightly varying the site of pressure. (2) *By instruments.*—The elastic tourniquet or some form of screw instrument may be employed. (3) *By flexion.*—Aneurysms in the popliteal region and at the bend of the elbow may in some instances be cured by fully flexing the joint, and so occluding the sac by pressure. All the methods of compression are both painful and uncertain procedures, and are very rarely resorted to except as a preliminary measure or in cases in which operation is refused or is impossible.

The Introduction of Foreign Bodies to Procure Coagulation.—Many ingenious methods have been devised for producing coagulation within the sac, *e.g.*, electrolysis, galvano-puncture, introduction of wire, etc. In the majority of cases the aneurysms have been of the abdominal aorta, in which case no other treatment is available; although in some instances there has been brilliant success, on the whole these methods are disappointing.

Arteriorrhaphy.—Dr. Matas[2] has devised a method of treating aneurysm by suture of the opening between the sac and the trunk of the artery or by complete obliteration of the sac by suture. The method is complicated and seldom practicable; further, the cases suitable for this operation are eminently suitable for excision, which is less risky and more certain in its results.

Amputation.—As a primary operation amputation is indicated in cases of rupture of an aneurysm or for suppuration within the sac, or in very rare instances for the cure of an aneurysm proximal to the site of amputation by diminishing the flow of blood through the sac. As a secondary operation, it may be required for gangrene following ligature, or for secondary hæmorrhage after ligature.

Summary.—(1) Where possible, excision is the ideal operation.

(2) Proximal ligature is indicated where excision is impossible for anatomical reasons.

(3) Distal ligature is successful in some cases, but is only to be resorted to when the former operations are impossible.

(4) Operations such as arteriorrhaphy, introduction of foreign bodies, etc., are occasionally successful, but are not to be preferred to the former methods when these methods are practicable.

The Treatment of Certain Special Aneurysms.—*Thoracic Aorta.*—Distal ligature, electrolysis and the introduction of wire have all been attempted, but no success other than temporary improvement appears to have resulted; in the case of distal ligature, rapid increase in size of the aneurysm from increase of the pressure within the sac has occurred in some instances.

Innominate Artery.—Distal ligature of the common carotid and the third part of the subclavian artery has been followed by success; ligature of the vertebral artery so as to almost entirely stop the flow of blood through the sac may be also performed, either at the original operation or at a second operation, if the pulsation in the sac is still marked.

Common Carotid Artery.—When possible, excision should be performed, the distal ligature being made first to prevent embolism. If excision is not practicable, proximal ligature is indicated, preceded, where possible, by distal ligature either of the common trunk or of the internal trunk so as to avoid a cerebral embolism. Failing the two previous measures, distal ligature of the common trunk or the internal and external carotid arteries is called for.

Internal and External Carotid Arteries.—Excision is practicable in some instances, especially in the case of the external carotid; in other cases ligature of the common carotid should be performed.

Intra-cranial Aneurysm.—If diagnosed, this condition may be relieved by ligature of one or both the internal carotid arteries.

Intra-orbital Aneurysm.—This aneurysm usually follows fracture of the anterior fossa of the skull. Many cases have been cured by ligature of the internal carotid artery.

Subclavian Aneurysm.—Proximal ligature is rarely possible; a few cases of successful ligature of the innominate or first part of the subclavian have been recorded. Distal ligature is likely to fail owing to the large branches arising from the first part of the artery; amputation through the shoulder-joint preceded by ligature of the axillary artery as high as possible may be resorted to if all else fail.

Axillary Artery.—Excision of the sac is rarely possible owing to the intimate relations of the brachial nerves to the artery. Compression or ligature of the third part of the subclavian is indicated.

Abdominal Aorta.—The introduction of wire and electrolysis have both been attempted, but without any permanent success.

Iliac Artery.—An aneurysm of the common iliac artery at its origin from the abdominal aorta can only be treated by distal ligature, a proceeding which is not likely to succeed owing to the promixity and direct continuity of the aortic trunk. Aneurysms of the lower part of the common iliac and of the internal or external iliacs should be treated by proximal ligature; in the case of ligature of the common or external trunks the risk of gangrene in the lower extremity must be remembered and guarded against.

Gluteal and Sciatic Aneurysms.—These aneurysms are readily dealt with by ligature of the internal iliac artery; in certain cases they may be treated by excision.

Femoral Aneurysm.—The precise method of treatment depends on the site of the aneurysm; proximal ligature of the external iliac or of the femoral trunk above the aneurysm is usually necessary.

Popliteal Aneurysm.—Many cases have been cured by compression of the femoral artery. Ligature of the superficial femoral artery at the apex of Scarpa's triangle is a very successful operation, but owing to the large branches given off between the site of ligature and the aneurysm a more certain result is likely to be obtained by ligature of the popliteal artery at its highest point or of the femoral artery in Hunter's canal. Excision is practicable in some cases if the swelling is small.

Diffuse Aneurysm.—By the term "diffuse aneurysm" is meant either that the sac of an aneurysm has given way, or that as the result of an injury an artery has been ruptured and hæmorrhage is taking place into the surrounding tissues. In either case the immediate treatment consists in stopping further hæmorrhage by the application of a tourniquet, or by digital pressure over the trunk of the affected artery above the site of rupture. Subsequently, in the case of a small vessel, the condition is to be treated by cutting down on the swelling and after turning out the blood clot ligaturing the bleeding points. If a large vessel has been injured, or if the condition results from the rupture of an aneurysmal sac, ligature of the vessel above the site of rupture should be undertaken in the first instance, to be followed by local treatment on the same lines as indicated above if the pulsation persists or recurs. In the case of rupture of the main vessel of a limb, whether previously aneurysmal or not, the soft parts may be so extensively injured by the effused blood that amputation is likely to become necessary.

Arterio-venous Aneurysm.—A communication between an artery and a vein is almost always traumatic in origin. The communication may be direct (aneurysmal varix) or indirect, *i.e.*, a short track connecting the two vessels (varicose aneurysm). If the swelling is small and causes no symptoms, no treatment is required apart from local support and protection by means of an elastic bandage; if, however, the swelling tends to increase in size or is painful, the effect of digital pressure on the artery above the swelling should be tried; this method will often be found successful, as in most cases small arteries are affected; if, however, it fails or if a large artery is involved, ligature of the artery above and below the aneurysm is indicated.

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EMBOLISM (EXCLUDING CEREBRAL EMBOLISM).

FIVE main varieties of embolism may be met with : Air Embolism, Fat Embolism, Embolism by Tumour Cells or Parenchymatous Cells, Embolism by Fibrinous Particles which may or may not be infective, and Embolism by Bacillary Plugs.

Air Embolism is probably much less common than has been thought; it is most frequent after surgical operations about the head and neck. Treatment has but little effect on this condition, but oxygen inhalations and free stimulation are indicated.

Caisson Disease or diver's paralysis is probably one form of air embolism. The most successful treatment is re-compression, which causes re-absorption of the nitrogen bubbles and consequent cessation of the unpleasant symptoms. If the patient is now very gradually decompressed, recurrence of the distressing phenomena may be averted. If this treatment proves unsuccessful, expectant treatment must be adopted; morphia must be freely used to relieve the intolerable pains, and fomentations and abdominal friction may alleviate the abdominal pain and vomiting.

Fat Embolism does not commonly give rise to symptoms. In rare cases extensive fat embolism in the lungs or brain may cause death. Cardiac stimulants and oxygen inhalations may be of service should the embolism be of the pulmonary type, while the treatment of the cerebral type is that of cerebral embolism from any other cause (*see* Cerebral Embolism, Vol. II.).

Embolism by Tumour Cells is only susceptible of treatment in so far as the metastatic growths may or may not be removable.

Embolism by Parenchymatous Cells is a histological curiosity for which no treatment is required.

Embolism by Fibrinous Particles may result directly from cardiac or arterial disease or indirectly from affections of the veins. Two main classes of such emboli are recognised, infective and benign; it is, however, probable that, strictly speaking, the great majority are infective, though in the so-called benign cases the organisms present are of extremely low virulence. Embolism by Bacillary Plugs is a variety of infective embolism.

In the treatment of *infective embolism*, wherever the emboli may be situated, the great indication must be to treat the underlying septicæmia or pyæmia, as the case may be (*see* articles on

Septicæmia and Pyæmia). The general treatment of *benign embolism* is the same as that of venous thrombosis (*see* Special Article, p. 1328). The patient must rest in bed, all sudden movements must be prohibited, and the general health must be maintained at as high a pitch as possible.

If the occluded artery is accessible, the advisability of performing arteriotomy and removing the embolus may be considered. This manœuvre has been reported on favourably by Moynihan[1] and Handley.[2]

Occasionally gangrene of a limb may result from embolism; this condition must be dealt with on its merits.

Certain special sites of embolism may be mentioned separately:

Pulmonary Embolism.—This condition may arise from endocarditis of the right heart, from thrombosis in the right auricle or ventricle or right auricular appendix, or from the separation of portions of clot from thrombosed systemic veins. It is probable that many of the cases of pleurisy which have been reported as following anæsthesia for operation such as varicocele and the like, are in reality secondary to pulmonary infarction following venous thrombosis.

If the embolus is of such size as to occlude the pulmonary artery or one of its main branches, death commonly results in a few moments. The administration of oxygen inhalations and the subcutaneous injection of ether, brandy, strychnine, etc., are not likely to prevent a fatal issue, neither has the operation of arteriotomy and removal of the embolus, as reported by Trendelenburg,[3] Sievers[4] and Ranzi,[5] proved satisfactory up to the present.

The remedies above mentioned are, however, of service in combating the immediate distress consequent upon the lodgment of lesser pulmonary emboli. The patient should be propped up in bed, and the stimulation should be continued so long as the distress persists.

Common complications of pulmonary infarction are pleurisy and hæmoptysis. The pain of the pleurisy may be relieved by a belladonna plaster, by strapping the chest or by the application of two or three leeches. If the embolism is infective, empyema may result; this must be treated on its merits. Hæmoptysis is rarely profuse; it must be treated as is hæmoptysis from any other cause.

Embolism of the Spleen may cause considerable pain. This may be alleviated by the application of a belladonna plaster or by strapping the lower left ribs.

Embolism of the Mesenteric Arteries.—If the infarction is complete, surgical operation with resection of the affected loop of gut offers the only chance of recovery. The majority of patients in which this condition occurs are not in a fit state to stand a severe operation. It is to be noted that *thrombosis* of the superior mesenteric artery may occur so gradually as to permit of a collateral circulation being established.[6]

Embolism of the Kidneys.—Cupping the loins or the application of a belladonna plaster may relieve the pain. The hæmaturia requires no special treatment other than rest and a bland diet.

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DISEASES OF VEINS.

VARICOSE VEINS.

THE first essential in discussing the treatment of varix is a due appreciation of the fact that the mere existence of varicose veins does not necessarily call for treatment. With certain exceptions, varicose veins which cause no inconvenience or discomfort should be left entirely alone; treatment in such cases often leads to harm, and in the end may produce symptoms which in the absence of mischievous interference need never have arisen at all. The exceptions to this statement are provided by the requirements of the public services, the existence of well-defined cysts or other conditions in localities exposed to injury, and the occurrence of isolated and limited masses of congenital varix, which can be completely cured by operation.

Only a small minority of cases of varicose veins are curable in the proper sense of the word. Acquired varix in the very early stage in young growing subjects is curable; so also is circumscribed congenital varix, if its arrangement is such that it can be completely extirpated. All other varieties of varicosity are incurable in the true sense, although in the majority the symptoms arising from them can be alleviated or entirely removed by rational treatment, by which in many cases incalculable good can be done; on the other hand, meddlesome interference is invariably productive of harm.

As a preliminary to the proper understanding of the rational management of varicose veins a knowledge of the following points is important.

Varix rarely becomes obvious before puberty, but at or about that time it will be found that in fully 5 per cent. of boys the veins of one or other lower limb are abnormally large. Between puberty and the ages of twenty to twenty-five years the majority of cases of congenital varix make themselves manifest, although they do not as a rule give rise to trouble. Acquired varix in young subjects generally makes its appearance between twenty and twenty-five years of age. A matter of considerable practical importance is the difference in the relation of the appearance of the varix and the symptoms arising in connection with it in congenital cases and in those of the acquired kind. *In congenital cases the appearance of the varix is invariably prior to the occurrence of symptoms arising from it; in the acquired kind, on the other hand, feelings of discomfort, such as pain, weight and leg weariness, generally precede the manifestation of the altered veins and call attention to them.* It is further undeniable that varix following upon symptoms of this kind is a far more serious condition than varix which, having previously been in existence, is in due course productive of trouble, since the former indicates a degenerate change in vessels originally normal, whilst the latter indicates the secondary consequences following in vessels originally defective congenitally, the results of which are comparatively unimportant when compared with those following upon acquired varicosity. Varix making its first appearance after twenty-five years of age is invariably due to exaggerated strain, to thrombosis, to laceration of vessels such as may occur in a case of bad fracture, or some other cause producing prolonged obliteration of the proximal vein channels.

The term " spontaneous increase " is a convenient description of the growth in varix which takes place without obvious cause (such as thrombosis, injury, and the like). It is, in fact, the sort of increase in the condition commonly complained of by patients who, whilst they notice the alteration, can assign no reason for it. This spontaneous increase is prone to show itself at, or soon after, puberty; between the ages of twenty and twenty-five years; at about the age of from thirty to thirty-five years; and between forty-five and fifty years; if varix has shown no sign of increase at fifty years of age it rarely grows spontaneously afterwards. After sixty or sixty-five years of age there is generally a tendency of the abnormal vessels to diminish in size, and trouble rarely rises in connection with them after that age, unless thrombosis, injury, or some other changes lead to mischief. The largest number of cases of spontaneous increase commence between twenty and twenty-five years, *i.e.*, at the time of cessation in the growth of the individual; and the explanation of this, which is interesting, seems to be as follows. The cases are nearly always of the congenital type, and the altered veins which during the period of the growth of the individual increase only in proper proportion to his or her growth, partaking of the eccentricity in behaviour which is a common characteristic of all abnormal structures, continue to increase after the growth of the patient has ceased; hence a condition which attracts no attention in developing people becomes aggressively manifest when its growing period is continued beyond that of the persons whom it affects. The increase between thirty and thirty-five years of age is not so easily explained, but it is probably due to the effect of strains and exertion during the previous ten years which, although not severe enough to attract attention, prove after a period to be sufficient to bring about changes in the vein valves which lead to increase in the varix; the years preceding the time mentioned being those in almost all classes of life in which the hardest physical work is done. The increase at about fifty years of age is probably due to the commencing insufficiency in the vein valves which occurs more or less in all veins, whether normal or abnormal, at or soon after that time of life, and by the time that the age of sixty-five years is reached it is quite the exception to find any ordinary person without veins which are abnormally large on account of the further progress in the insufficiency of the vein valves.

VARIX OF THE LOWER EXTREMITIES.

For practical purposes the treatment of varicose veins is almost entirely limited to the lower limbs, as in other situations troubles rarely arise in connection with them excepting from injury.

The methods of treatment may be classified under two heads: (1) Non-operative, (*a*) hygienic, (*b*) massage, and (*c*) mechanical supports; and (2) operative or radical.

(1) **Non-operative Treatment.**—(*a*) *Hygienic.*—This amounts to little more than the scrupulous avoidance of constipation, the use of rather tightly fitting, well-ventilated (*i.e.*, very porous) drawers, linen by choice, for the affected limbs, and the avoidance of extremes in the temperature of the daily bath. The intensely cold bath so much in favour is not advantageous in cases of varix, excepting during the growing period of life, and cases of thrombosis caused by the use of the extremely cold bath by persons with pronounced varix over forty-five years of age are not uncommon. Speaking generally, the tepid bath is the best for those suffering from varicose veins—of this there is no doubt. The treatment of increasing uncomplicated varix by complete rest is unscientific and harmful; moderate exercise with horizontal posture in the intervals is the indication. Long-continued standing, especially in the same position, is the thing most to be avoided. Varicose veins arising spontaneously are, as a rule, due to some congenital defect or peculiarity in the venous apparatus, and are often associated with a tendency to flat-foot and knock-knee, separately or together. A careful examination

therefore in all cases of varix of the lower limbs is imperative, with a view to the detection and, if present, the rectification of either of these defects, which if neglected tend to increase the growth of the varicose veins and to render their treatment difficult or useless.

(*b*) *Massage.*—When intelligently applied in early increasing varix in growing people the progress of the defect can be frequently entirely checked by massage, if the patient will submit to the necessary sacrifice of time and to the expense. A practical cure can thus be effected if the insufficiency of the vein valves is only just commencing, and if this change is further advanced, considerable permanent benefit can be obtained. In those who have reached full adult life, the growing period having ended, the benefit of massage, although it may be great, is only temporary, excepting in cases with early œdema, when permanent relief from that defect is frequently obtainable. Speaking generally, the only cases in which massage can be used with impunity are those in which the veins immediately empty themselves spontaneously in the horizontal position. If the emptying of the veins in this position is sluggish or incomplete, it is a sure sign of definite obstacle to the blood return, and massage should be employed with caution. Varicose veins consequent upon fracture are rarely benefited by massage. One of the most useful and practical points in connection with the treatment of varix by massage is the remarkable improvement which follows the rubbing of the varicose part with alcohol night and morning. As an adjunct to massage it is invaluable; by itself it is often most satisfactory, although not so much so as when massage is also used. Absolute alcohol or pure ether is the best form, but ordinary methylated spirit will serve the purpose, and is, of course, less expensive. For the alcoholic treatment the skin of the affected part should be sound, and any sign of eczema, however slight, contra-indicatives its use. Massage when used should be employed daily, and if any permanent or prolonged benefit is to arise nothing short of a course of three months is worth the expense and trouble of carrying it out. The important points in the method of its application are these: (1) The various manipulations of massage may be applied over the whole limb, excepting along the line of the large varicose vessels, where smooth rubbing only is admissible; no tapping, pinching, or abrupt manipulations being there used; and (2) the time employed in each application of massage should be divided into two equal parts. During the first the limb should be vertical; during the second part of the time it should be flat, or better, a little dependent. In considering the principle upon which the massage treatment is based, it must be borne in mind that the better the muscular development in a limb the better, speaking generally, are the conditions which help the venous circulation. The association of electricity, especially in the form of the electric bath, with massage, is very advantageous, but the difficulties connected with its proper application render it comparatively useless in ordinary practice.

For those in a position to afford the expense the course of treatment adopted at certain continental health resorts, notably Bagnoles-de-l'Orne, is strongly indicated in cases of increasing varix, especially if there has been any question of thrombosis, in which the benefit derived is sometimes very remarkable.

(c) *Mechanical Supports.*—The irrational use of this form of treatment is largely responsible, not only for the growth of previously quiet varix, but also for many of the complications which arise in connection with it. The accidental discovery of varicose veins in a limb is no justification for the employment of a support of any kind. The onset of discomfort, or of other signs that the condition is about to give rise to trouble is the earliest justification for the use of mechanical supports. It is not unusual to hear a person congratulate himself upon having taken to the use of an elastic stocking because the veins have been steadily increasing in size subsequently, which has led to the conclusion that they would have been even worse had the support not been used; in many of such cases the stocking has been the sole cause of the increase. A rapid growth of varix in the thigh frequently follows the use of a support in quiet varix of the leg. Supports for the lower limb should never be worn above the knee in uncomplicated cases. Not only are they unnecessary, but the impossibility of preventing the formation of folds and wrinkles about the knee makes their use exceedingly harmful as every fold represents a constricting band—the thing above all others to be avoided around a varicose limb. The fact that many people who, upon discovering the existence of varicose veins, have taken to the use of a support declare that they miss it greatly if it is discontinued, is no proof whatever that it has been doing good, as any garment which clings closely to a limb would naturally be missed for a time after the discontinuance of its use. A properly applied support at the onset of pain, discomfort, or œdema in varix is a most satisfactory and useful means of giving relief and comfort in some cases, but it should be used with judgment. In the effects immediately following the use of a support two points are essential as indications of its safe employment; these are, first, the relief of the symptoms for which it has been used, and, secondly, the absence of continued coldness of the feet after its application. The failure to give relief or the presence of coldness of the feet, either separately or together, are sure indications that the support either does not fit, has been improperly applied, or that the method of treatment is not suitable for the case.

With regard to the form of support a well-applied porous bandage is undoubtedly the best, the most satisfactory being the *Crêpe Velpeau bandage* in consequence of the ease with which it can be applied, as no " turns " are necessary, and because although it is sufficiently elastic, it contains no indiarubber or other easily perishable material. The unperforated rubber bandage should never be used ; the perforated rubber bandage is admissible in some circumstances, but it should always be worn over a thin stocking and not next to the skin.

The advantage of bandages over other forms of support lies in the fact that they can be applied tightly or loosely according to the changing requirements of the limb; against them, however, is the difficulty found by many people in their proper application. The most generally useful support, therefore, for those who can afford to have the right kind, is the *elastic stocking*. This, however, unless perfect in fit and in the degree of pressure which it exercises, is frequently very harmful. There is only really one satisfactory kind, namely, that which is called "spiral," in which the pressure is precisely like that of a bandage and which has the facility of accommodating itself to the varying changes in the limb in a way that no other stocking does. An elastic stocking should fit with absolute accuracy and should not be too tight. Its tightness should be just sufficient to allow it to lie without a fold or wrinkle on the limb, whilst it is not tight enough to interfere in any way with the circulation in the toes. The occurrence of coldness of the feet following its application is a certain sign that the support is too tight or unsuitable and may produce serious harm.

When the size of the affected limb varies greatly from time to time or tends steadily to increase from continual engorgement the best form of support is a laced stocking which can be readily altered to meet the varying requirements of the limb, and in such cases remarkable improvement, often permanent, can be effected by the continual use of such a support by day and night for a period varying from one to six months or more, with of course the necessary removals for the bath, etc. In cases of varix following upon thrombosis, this plan is especially indicated. Theoretically the support of whatever kind should include the foot; practically, however, it will be found in many cases equally efficacious and more comfortable if it does not extend below the ankle.

(2) **Operative Treatment.**—Speaking generally, operation in uncomplicated varix should be regarded, with certain exceptions to be presently indicated, as a measure for the relief of symptoms, the prevention of complications, or as a check to the progress of the defect rather than as a cure in the true sense of the word; a realisation of this fact will prevent much disappointment to patients and possibly discredit to the practitioner. The only cases susceptible of cure in the true sense are localised masses of varicose veins, especially when congenital, and very early cases of incipient or increasing general varix in growing subjects.

From the point of view of operation, uncomplicated varix of the lower limbs may be divided into two classes: one in which the defect is distinctly localised within well-defined limits; the other in which the condition is more or less general.

Cases in which varicose veins have developed as collateral channels are not suitable for operation unless the circulation through the veins originally obstructed has become freely reestablished.

In general saphenal varix the success of the treatment depends upon two main factors: first, the performance of a proper operation, and, secondly, a sufficiently long period of rest after the operation to allow of an adequate restoration of the balance of the circulation before any serious attempt at getting about is made by the patient. Judging from cases coming under observation from time to time, the importance of the second point is imperfectly appreciated. If a really successful result is to be obtained, three weeks at least should elapse after operation before a patient is allowed to make any material attempt at walking, and from six weeks to two months should be allowed to pass before anything like heavy ordinary exercise is resumed. It is only by the observance of these precautions that, in a case of any degree of severity, the full benefit of the operative treatment can be assured.

Excepting cases of local masses of varix which have been completely removed by dissection, it is a wise and helpful measure to wear a support, in the form of a light stocking or bandage, around the leg for three months subsequent to an operation for varicose veins of the lower limb, and in cases in which a support of any kind has been habitually worn before operation this precaution should be deemed absolutely necessary.

Operative Measures.—Localised masses of congenital varix, cystic dilatations, and aberrant varicose veins in dangerous places (Fig. 1), from the point of view of liability to injury, should be dissected out.

The most dangerous region in varix of the lower limbs may for practical purposes be marked off by two horizontal lines drawn around the limb, one about the level of the middle of the thigh, the other 3 inches below the line of the knee-joint, *i.e.*, at the point where the two main subcutaneous veins of the inner side of the leg join to form the main femoral trunk of the internal saphena (Fig. 3, c). Within this area the local conditions predisposing to thrombosis are present in a remarkable degree. Cysts often of great size are common (Fig. 2), huge dilated tortuous vessels, valveless and with abrupt bends, are frequent, and are constantly being subjected to straining movements produced by flexion and extension of the knee. The special liability to injury of these conditions

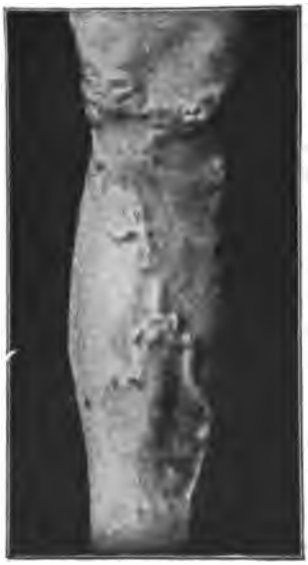

FIG. 1.—General varix of the lower limb, showing aberrant varicose vein crossing the shin. The most dangerously placed vein met with in varix of the leg. (From Bennett's Varix & Thrombosis, Longmans.)

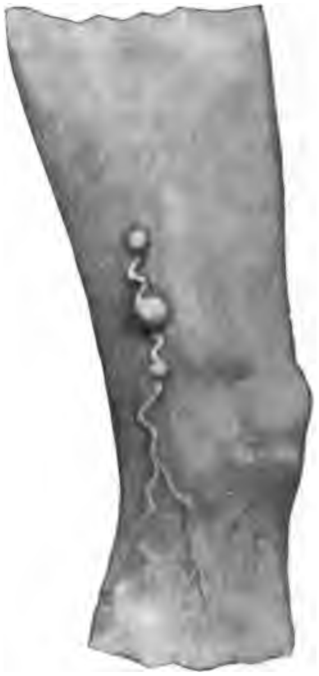

FIG. 2.—Superficial venous cyst, connected by tortuous and dilated veins overlying the saphena at the inner side of the knee. (From Bennett's Varix & Thrombosis, Longmans.)

about the inner side of the knee and thigh in riding and many other amusements and occupations is obvious. So far as the writer's experience goes, almost all cases of thrombosis in varix of a grave nature, apart from those arising from inflammation or other septic conditions in other parts of the limb, originate within the limits of this dangerous area.

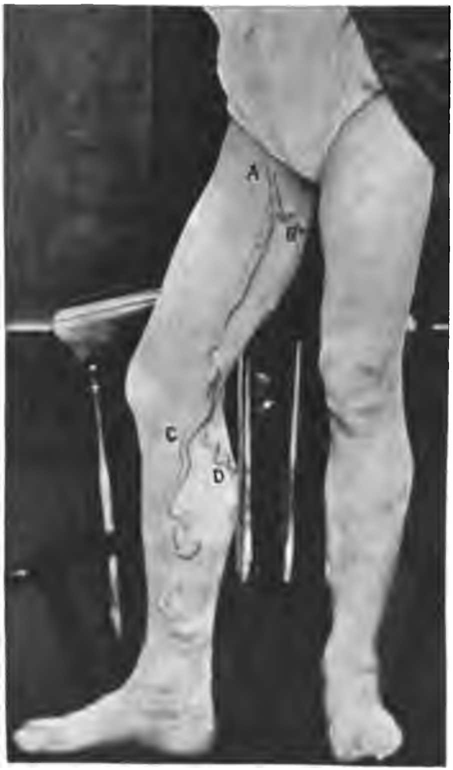

FIG. 3.—Photograph of the simplest form of general varix of the internal saphenal vein. In such a case the high operation would involve the removal of the portion of the vein extending from A above to a point below the junction of the posterior femoral branch B. Below, if the varix markedly involved the back of the leg, 3 inches of the saphena immediately below the line of the knee-joint should be removed, including the junction of the posterior branch D. If the calf is practically free from marked varix, 3 inches of the saphena C below the junction of D should be removed.

In the treatment of general saphenal varix the main point to bear in mind is that no matter how exaggerated the condition in the leg may seem the cure or mitigation of the condition can only be effected by the removal of a portion of the long saphena vein high up in the thigh, immediately below the saphenous opening, which is best done by removing about 2 inches of the vein after a thin carbolised catgut ligature has been applied above and below, care being taken that the junction of the large posterior tributary from the inner and back part of the thigh is included in the part excised (Fig. 3, A, B). This operation was advocated and performed by the present writer as far back as 1883, and its propriety emphasised in some lectures published in 1887. In all cases, even if the varicose condition of the leg is of the most extreme kind, a general shrinking of the affected veins below the seat of operation follows, provided a sufficient period of rest is allowed after the operation. No interference with the vessels in the leg is therefore actually necessary, but there is no doubt that the improvement of the general condition is more rapid if 3 inches or thereabouts of the saphena are removed below the knee.

If the varicosity in the leg is mainly limited to the long saphena and its intimate branches, the portion resected in this part of the limb should be immediately below the point at which the large posterior tributary joins the main vessel; if, on the other hand, the varix involves the calf region to any extent, the junction of this tributary should be included in the portion removed (Fig. 3, D). When well-defined cystic dilatations exist along the line of the saphena above the knee, it is better to remove the whole of the saphena in the thigh from the saphenous opening downwards, stopping short just above the knee. When this is done resection of the vein below the knee is unnecessary. It is desirable in operations of this kind to avoid leaving a scar along the inner side of the knee-joint if possible, as such scars are liable to remain sensitive and irritable for some time. What has been said with regard to interference with the veins in the leg after the high operation applies to ordinary cases in which the sole object is the arrest of the increase in the varicosity or to diminish or prevent complications arising in connection with it. When the operation is performed to satisfy the requirements of the public services, it is better to remove all the more prominent or objective masses of varix in addition to interrupting the saphena higher up.

The extensive varicosity often seen in women on the outer side of the thigh extending from the knee to the level of the buttock is of importance on account of the free and direct communication with the deep pelvic veins. It is of two types, one in which the veins are only moderately prominent, but very numerous, commencing below in small radicals, having no apparent communication with the larger veins; the other type, on the contrary, is composed of large, tortuous, and sometimes sacculated veins, which communicate freely with the saphena by branches passing in front of, or behind, the thigh. The first type is not benefited by operation, but in the second variety the removal of from 3 to 6 inches of the more prominent veins on the outer side of the thigh is followed by great improvement, especially if combined with the high operation upon the saphena should that vessel show any signs of dilatation, and operation in this external femoral varix when discovered before marriage should be recommended, as the chances of complication arising in connection with it during child-bearing are thus undoubtedly rendered less if they are not entirely annulled.

When the varicose condition is confined to the leg involving the external saphena vein and its tributaries, the same principle of treatment should be followed as in dealing with internal saphenal varix; the external saphena should be interrupted immediately below the point at which it joins the popliteal veins and any aggressively prominent or sacculated masses of veins in or about the calf removed (Fig. 4). The operative treatment of varix of the lower limbs here described is that which the writer during an exceptionally large experience has found to be the most certain in its results.

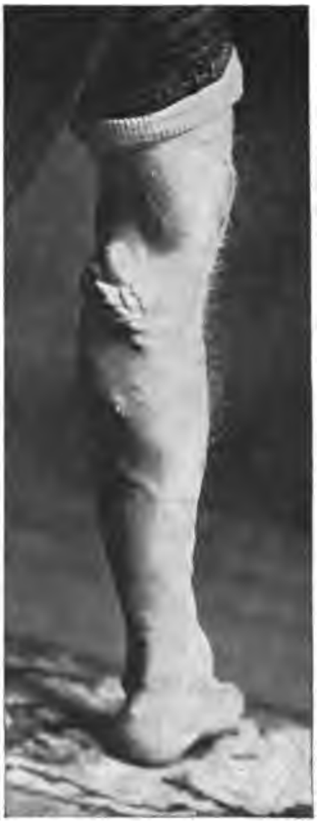

FIG. 4.—Extensive varix of the external saphena vein, with very large cyst at the point at which it dips in to join the popliteal veins.

Recently (Journal des Praticiens, September, 1910), Dr. Delbet advises in cases of large varices of the lower limbs anastomosis by operation between the saphena and femoral vein, and states that he has performed the operation "many times" without accident or failure. It is, however, obvious that very definite evidence of the advantageous results thus obtained must be forthcoming before an operation possessing such potentiality for harm can be recommended.

VARIX AFFECTING THE TRUNK.

This rarely calls for treatment unless injury has caused laceration or thrombosis. Isolated masses of varicose veins are occasionally met with in various regions; they are as a rule congenital and of little consequence; they are in fact merely glorified angiomata and should be treated as such by removal or other appropriate measures if situated in regions liable to injury, or if painful, as is sometimes the case.

Very extensive arrangements of varix occasionally occur about the chest and abdomen; in the former region it is sometimes congenital and associated with other vascular peculiarities and may for practical purposes be ignored, but both about the chest and abdomen developments of this kind are nearly always merely evidence of obstruction of deep vessels and are symptomatic only, and so do not call for treatment directly unless sacculation has led to so much thinning of the walls of the vessels as to put them in danger of bursting, when the area of the varix thus affected may be with advantage included between two ligatures and removed; localised thrombus, if causing acute pain, may be dealt with in the same way.

The commonest situation on the trunk for the development of exaggerated varix is in the supra-pubic region in consequence of blocking of the iliac veins, such as may occur during enteric fever and other conditions, *e.g.*, fracture of the pelvis. In such cases the hypertrophied vessels are engaged in carrying on the collateral circulation necessary after the obliteration of the main channel. Under these circumstances any attempt at removing them by operation is, generally speaking, illogical and must in course of time be followed by the formation of new collaterals. The only justification for operation in such cases is the occurrence of changes in or about either of the veins which renders the bursting of the vessel probable, the formation of localised thrombus, and occasionally the occurrence of acute pain from the irritation of some nerve filament by a greatly distended vessel.

For practical purposes, however, the supra-pubic varix, although often alarming in appearance, may be disregarded, an attitude which may require some skilful argument to justify it in the mind of the nervous layman.

VARIX OF THE UPPER EXTREMITIES.

Varicose veins in the upper limbs are common, but rarely give rise to trouble. Some are congenital, but the majority occurring before middle age result from overstrain. Dilated and tortuous veins will be found in some part of the upper extremities in most men after the age of forty-five or fifty; in women they are not so marked.

Very rapid increase in size and tortuosity in the veins of the forearm occasionally follows a sprain or other injury at the elbow, and marked varicosity of the veins in the bicipital region may follow injuries about the shoulder. The pain in the limbs felt some time after an injury of this kind, although as a rule attributed to the immediate effects of the damage, is often really due to the painful distension of the veins and ceases when these have become well dilated. The writer has had to remove portions of dilated veins in the upper limbs in eighteen cases, three for thrombosis, five in dilatations occurring in dangerous situations, and ten for the relief of pain arising when the dependent position led to painful distension of the vessels. In the early stages of dilatation massage is of much help and electricity in similar cases often produces immediate benefit, but the high frequency current should be avoided; a habit of sleeping with the hands above the head should, if possible, be cultivated.

Varicose veins are also met with about the head and neck, but seldom, for obvious reasons, give rise to any symptoms unless due to deep obstruction, when they are, of course, merely symptomatic and do not lend themselves to treatment. Considerable cystic dilatations, however, are sometimes seen in the subclavian region and may require removal if choked by thrombus, or if, as sometimes happens, they cause distressing pain. In operating upon these sacculations it must be borne in mind tha very exaggerated saccular dilatation of the lower part of the internal jugular vein, which sometimes occurs, may simulate sacculations of more superficial and less important vessels from the operative point of view.

Spontaneous Disappearances or Shrinking of Varix.—Varicose veins may diminish in size, and if localised may entirely disappear after injury resulting in limited thrombosis. In varix which is not caused by the dilatation of veins acting as collateral channels of circulation, this improvement may be permanent. If, however, the vessels concerned are of the nature of collaterals the benefit will, speaking generally, be temporary only as further collateral channels will develop. Great diminution in varix is common in old people, and as a rule is due to the formation of multiple passive thrombi, which may often be felt in great numbers in people of advanced age. These passive thrombi give rise to no pain as a rule, are quite insensitive to the touch, and are generally entirely unnoticed by the patients.

It is sometimes stated that varix tends to disappear spontaneously in the aged; this is one of the many traditional myths which die hard. It is true, however, that when all the vein valves have become incompetent the size of the dilated vessels becomes more generally uniform, the whole varix appearing, therefore, less knotted, and a deceptive impression of diminution or disappearance may thus be formed.

Recurrence in Cases of Varix after Operation.—This must be considered under two heads: (1) The recurrence of the symptoms for which the operation has been performed; and (2) the appearance after operation of other varicose veins.

The recurrence of symptoms after operation may be attributed to one of three causes: The selection of cases unsuitable for the radical treatment; the performance of an inadequate or unsuitable operation; or an insufficient period of rest after the operation to allow of the proper restoration of the balance of the circulation which has been upset for the time being by the treatment.

The appearance of other varicose veins after operation is a matter of no consequence, if the symptoms for which the treatment has been adopted do not recur.

It is necessary to bear in mind, and to warn patients to this effect, that in all cases in which varicose veins are acting as collateral channels of circulation the removal of portions of such veins will be followed by the appearance of others to take up the work of those which have been interrupted by the operation. Cases of collateral varix are, as a matter of fact, generally unsuitable for operation, and should not be dealt with by that method unless pain, thrombosis or dangerous thinning of the vein walls make operation imperative; and in such cases the patients should be made thoroughly to understand that the object of the operation is to remove the causes of local symptoms or conditions and not to cure the varix.

WILLIAM H. BENNETT.

VARICOCELE.

Although a common affection, this is one which in well-ordered subjects rarely calls for treatment; it may in fact, as a rule, be regarded merely as a peculiarity of development which in many cases remains unrecognised throughout life.

In a small proportion of cases, mainly those occurring in nervous or abnormal individuals, symptoms requiring treatment arise, but the majority of patients who seek medical advice are led to do so either by the accidental discovery of an abnormal condition which naturally for the moment causes anxiety, or by the requirements of the public services, in which varicocele is still considered to be a physical defect which needs to be remedied.

Of persons seeking treatment for symptoms arising in varicocele the majority are nervous or disordered in mind, who after the discovery of the condition become so apprehensive of its effects upon the sexual powers that they think of little else, a state of things prone to lead to sexual hypochondriasis, which in its extremist form may end in insanity. In grave cases of this kind the result is frequently due to the exaggerated prognostications of quacks and charlatans, or a persistent study of literature dealing with the subject. Although the majority of the symptoms associated with varicocele are in themselves of little consequence and sometimes imaginary, great discretion is necessary in dealing with these cases as, if the symptoms described are regarded too lightly, the result will probably be to drive the patient into the hands of unorthodox practitioners.

In **general treatment** the main indications are the prevention of abnormal tension in the veins by the avoidance of constipation and the securing of free intestinal evacuation. In the peculiar mental state which occurs in exaggerated sexual hypochondriasis, rational and sympathetic advice as between man and man, based upon logical grounds likely to appeal to the reason of the patient, is more likely than anything else to bring about the desired change in the mental mood, for a time at all events, and the importance of plenty of occupation, preferably in the open-air, as a means of distracting the mind from the continual contemplation of the possibilities of the complaint cannot be too strongly insisted upon. Nerve tonics, such as phosphate of zinc and nux vomica, and in young highly neurotic subjects valerianate of quinine may prove of use. Depressing drugs, the bromides for example, should be sedulously avoided, as should also the use of local treatment, as it merely tends to concentrate the patient's mind upon the complaint. A fatal mistake in the management of these cases is to allow the patient to think that the practitioner considers them trivial or the symptoms imaginary. Electricity, which is sometimes advised in cases of this kind, is almost invariably harmful. The frequent ablutions with ice-cold water, so commonly advised, do no permanent good and may cause considerable harm. In ordinary well-constituted individuals the slighter symptoms of pain, weight and general uneasiness are usually relieved by a suspensory bandage of the pattern that the patient finds most comfortable. In all large and very dependent varicoceles a support of this kind is a wise precaution against injury, especially in riding; ordinary varicoceles causing no symptoms should be left entirely alone, excepting in tropical climates, when a linen suspender should be worn.

Operative Treatment.—The object of this is to bring about the obliteration or shrinkage of the varicocele and shortening of the redundant cord by the removal of an appropriate length of the veins concerned. Operation may be (1) expedient, (2) necessary, or (3) unjustifiable.

Operation is expedient: (*a*) When the mere size of the varicocele is sufficient to lead to risk of injury, or causes so much inconvenience as to interfere with the proper continuance of the patient's ordinary calling; (*b*) in double varicocele, when there is reason to suspect material impairment of testicular function. Impregnation has followed operation in such cases after many years of sterility; (*c*) in the radical cure of hernia when varicocele co-exists; (*d*) in some cases of mental anxiety in the early stage with a view to allaying the apprehensions of the patient; (*e*) in Europeans changing their residence to a tropical country.

Operation may be necessary: (*a*) To meet the requirements of the public services; (*b*) when pain in well-ordered individuals yields neither to general management nor individual treatment, and interferes with the usual pursuits of the patient; (*c*) when local tenderness, not due to recent thrombosis or inflammation refuses to yield to other treatments; (*d*) in cases of rapid increase in size, apart from causes outside the condition itself.

Operation is unjustifiable: (*a*) When abdominal tumours or other causes of intra-abdominal pressure co-exist; (*b*) in organic disease or persistent engorgement of the liver; (*c*) in recent thrombosis; (*d*) when inflammation exists in neighbouring parts, *e.g.*, epididymitis; (*e*) when testicular disease is present; (*f*) in advanced hypochondriasis, monomania, melancholia, or when other evidences of mental insufficiency are present.

Operations Available.—Of the several ingenious methods for the radical cure of varicocele, most of which were devised before the period of surgical cleanliness, two only remain for serious consideration. In both the cord is exposed through an incision over the external abdominal ring which does not invade the scrotal tissues. The cord being thus brought into view, the veins in one of these methods are denuded, isolated, and ligatured, either separately or *en masse*, and a portion sufficient to rectify the abnormal length of the cord removed; the divided ends are then united by sutures, preferably catgut; the external wound is closed in the usual way and sealed with a collodion dressing, the scrotum being supported in a gauze suspender. The details of this operation are arranged with the special object of avoiding with certainty any damage to the spermatic artery.

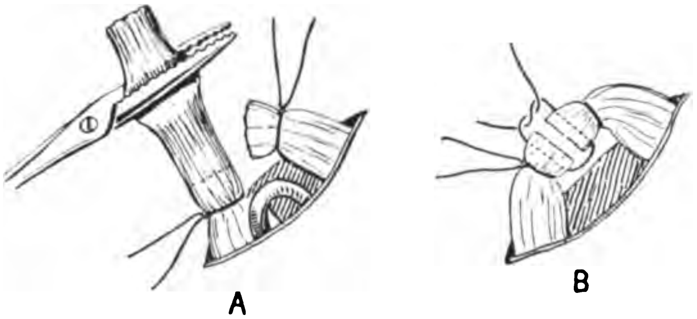

FIG. 1.—Diagram of operation for varicocele. A. Varicocele drawn up by forceps ready for application of second ligature just above bend of the vas deferens, which is seen arching out of the wound. B. The stumps free and ready for suturing.

The other method, which has been largely used by the present writer, is a modification of that introduced by him in 1887. The spermatic cord having been exposed, lying in its sheath of fascia, by an incision ¾ inch long over the external abdominal ring, is drawn up through the wound by means of forceps or a blunt hook. The whole thickness of the varicocele can now be seen through its sheath, which remains intact. Care having been taken to see that the vas deferens is not included, a catgut ligature is passed around the varicocele enclosed in its sheath by means of an aneurysm needle or eyed probe and tightly tied as high up as practicable, the varicocele being drawn downwards, a little out of the inguinal canal. The cord below, having been freed from its connection by a few touches wi forceps or director, is grasped in the blades of pressure forceps a divided between them and the ligature above, a sufficient "stump being left to carry a couple of fine catgut sutures. The cord grasp by the pressure forceps is now drawn out of the wound until t white cord of the vas deferens (Fig. 1) comes into view. Imm diately above this a second ligature is applied around the varicocel the veins of which have not been denuded. The redundant portio

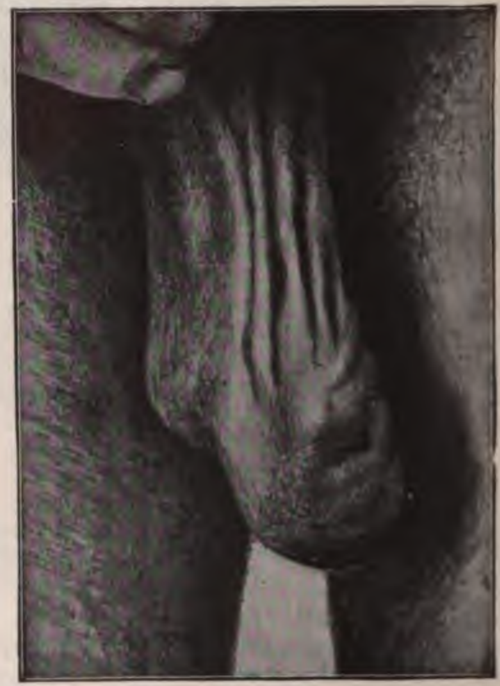

FIG. 2.—A varicocele which entirely disappeared after an injury which caused thrombosis. (From Bennett's Varix & Thrombosis, Longmans.)

is then cut off, and the two resulting stumps united by means two or three fine catgut sutures and allowed to drop back into t wound, the edges of which are brought together by catgut sutur and sealed with a collodion dressing, the scrotum being support in a gauze suspender. This operation differs from the first, inasmu as the spermatic artery is, as a rule, included in the ligatures a therefore divided. The main advantages of this operation ar The impossibility of recurrence and the avoidance of the necess for the use of a support after the operation; in addition to th is the fact that the interruption of the spermatic artery renders t testicle less liable to degeneration than when the veins alone are removed and the spermatic artery left intact. It has been proved beyond doubt that when the efferent vessels are alone removed, the full stream of blood being allowed to be pumped into the testicle by the spermatic artery, degeneration is more likely to occur than when the efferent and afferent vessels are of proportionate capacity, as they are in this operation as the testicular circulation is carried on mainly by the artery of the vas deferens and its corresponding veins. The fear of sloughing of the testicle existing in the minds of some people is groundless so long as complete surgical cleanliness is attained. As a matter of fact, the cases of sloughing of the testicles which have been recorded have been instances in which the veins alone were dealt with.

The convalescence from either of these operations should not exceed three weeks, a fortnight of which should be spent in bed. In the majority of cases it is possible for a patient to be getting about earlier than this, but, if the full benefits of the treatment are to be assured, adequate time must be given for the re-establishment of the balance of the circulation in the parts concerned. Moreover, attempts at getting about too soon after operation for varicocele are apt to be followed by the formation of hydrocele, which, although as a rule only temporary and not of much consequence, is an irritating and unnecessary complication.

Spontaneous Disappearance or Diminution in Size of Varicocele.—Varicocele in subjects over sixty or sixty-five years of age generally becomes less obvious with the declining activity of the sexual apparatus, and in some cases the veins shrink so much that they are hardly noticeable. In younger subjects a varicocele may disappear after injury in consequence of thrombosis leading to obliteration of the veins. Three cases of cure of varicocele in this way, following a blow from a cricket ball, have occurred in the writer's experience. Varicocele may for the same reason disappear after inflammation of the scrotal contents, *e.g.*, epididymitis.

WILLIAM H. BENNETT.

PHLEBITIS AND THROMBOSIS.

The treatment of phlebitis and thrombosis must depend largely upon its causation, and especially upon whether it is a local condition due to injury of, or changes in the vein, or a constitutional disease due to the infection or other morbid disturbance of the blood.

To consider first the local affection. If a vein is wounded, a clot forms around and usually within the vessel at the wounded spot, and the aim of treatment should be to prevent infection and favour healing. For this purpose the part should be kept at rest and sterile or antiseptic dressings carefully applied.

Should inflammation of the vein ensue and the thrombus spread within the vessel, search should be made for a source of infection. The wound should be examined, cleansed, and covered with a hot boracic fomentation which should extend over the inflamed vein.

In other cases of phlebitis the focus of infection may be found in a deeply-seated abscess, a suppurating wound, or an osteomyelitis, and the first essential in the treatment is the removal or disinfection of such focus. Abscesses must be freely opened and thoroughly cleansed and drained; suppurating or foul wounds must be disinfected; bones the subject of osteomyelitis must be removed by resection or amputation. An accessible vein containing septic clot should be ligatured above and below the thrombus and the portion between the ligatures excised. In cases of chronic suppuration of the middle ear giving rise to endophlebitis and purulent thrombosis of the lateral sinus, life may be saved by ligature of the internal jugular vein, and the thorough removal from the sinus of the infected clot (*see* Disease of the Ear).

Phlegmasia dolens is an example of septic phlebitis extending from the uterine veins through the iliacs to the femoral and other veins; treatment should therefore be directed to the removal of any morbid condition of the uterus (*see* Puerperal Infection, Vol. IV.). Sometimes the phlebitis would appear to be the result of the transmission of infecting organisms by the blood, and not of direct extension from the uterus.

The treatment of a case of **simple, non-infective phlebitis or thrombosis** consists chiefly in the enforcement of complete rest. The point to be borne in mind is the importance of taking every possible precaution against the detachment of clot and the consequent occurrence of pulmonary embolism and pneumonia. This is the chief danger, especially when the larger venous trunks are involved, and it belongs to the slight as well as to the severe cases. The patient must be at once and rigidly confined to bed, and must avoid all exertion; especially must he be warned against any straining effort, as for instance in defæcation. The bowels must be kept acting easily by gentle laxatives, and of course the bed-pan must be used. The neglect of this precaution has led to many disastrous results. If there is troublesome cough, laryngeal sedatives must be used and easy expectoration promoted, so as to avoid the disturbance and effort which cough involves. Should symptoms of pulmonary embolism occur, the thrombosed portion of vein from which the clot is being detached should if possible be removed and the vein ligatured. This is especially desirable in cases of thrombosis in varix.

To diminish the coagulability of the blood citric acid should be given (30 gr. of the acid dissolved in 2 oz. of water, three times a day); and if milk enters into the diet it should be decalcified as suggested by Sir A. Wright, by the addition of 30 gr. of citrate of soda to each pint of milk, which is thus rendered more digestible and less constipating. The diet should be light and easily assimilated; plenty of water should be taken; freshly-made lemonade is a useful beverage, and a moderate quantity of alcohol may generally be given with advantage. Tobacco smoking would seem to be harmless or perhaps even beneficial. The treatment must, however, be modified to meet the special conditions of those in whom the phlebitis is a complication of other serious diseases, as, for instance, in chlorosis, influenza and enteric fever.

In septic cases the treatment must be directed towards overcoming the septicæmia. The ideal treatment would be the administration of a reliable antitoxin, which would neutralise the effect of the bacterial infection, but the use of such sera in this condition has not hitherto been satisfactory. Quinine should be given in frequently repeated doses, and the strength supported by appropriate food and stimulants. The exclusion of all insanitary conditions should be carefully looked to, and the patient should be kept in a well-ventilated and light room, and removed as soon as possible into fresh and healthy surroundings. Pure air and sunshine are invaluable aids to recovery, and the high moorlands are more beneficial than the sea-coast.

The local measures should be directed to relieving pain and ensuring rest to the affected limb. For the relief of pain, nothing is so effectual as the application of heat; and as it is most important to disturb the limb as little as possible, it is best to use dry heat. Thin flannel bags, filled with bran and heated in an oven are convenient for this purpose; they are light and retain heat for a considerable time. When only a small portion of a vein is involved. a hot lead and opium lotion (liq. plumbi subacet., ʒij; ext. opii liq., ʒiv; water, ℥xx) [U.S.P. liq. plumbi subacet., ʒij; tinct. opii, ʒijs; water ℥xx] or a fomentation of boracic lint covered with jaconet is suitable; but the extensive use of wet applications is inconvenient and involves frequent disturbance. When pain is not severe the most comfortable dressing is a layer of Gamgee tissue secured round the limb by a many-tailed bandage, the skin having first been dusted over with powdered boracic acid. If the inflamed vein is superficial and tender, it is well to paint over it a thick lotion of oxide of zinc (powdered oxide of zinc, ℥j; carbolic acid, gr. 25; glycerine, ʒiij; water to ℥viij). I have never seen the least advantage from the application of belladonna, which, though often recommended, is disagreeable and useless.

When the veins of the upper limb are affected, the arm should be extended upon a pillow raised slightly above the level of the body and away from the side. It is best secured by wrapping a second pillow partially round the limb and fixing it by two or three separate strips of wide bandage. In this way sudden movements in sleep or otherwise are prevented. A similar arrangement can be adapted to the leg, or a well-padded splint may be applied and the limb slung from a cradle.

Gouty Phlebitis is sometimes the only manifestation of gouty inheritance, but it is frequently combined with other symptoms of the uric acid diathesis. It seems to me, however, that it is the fashion at the present time to attribute many cases of phlebitis, as of other diseases, to gout or the uric acid diathesis, when there is no evidence whatever of either the presence or inheritance of gout. When gouty symptoms are present they should be treated. The amount of solid food should be diminished and no meat allowed. Distilled water should be taken freely (2 or 3 pints in the twenty-four hours). This should be mixed with a carminative, such as ginger, as care must be taken to avoid flatulence, for any distension of the abdominal viscera is a serious embarrassment to the circulation. The bowels should be purged by an occasional colocynth and henbane pill, with sometimes a small dose of calomel.

Syphilitic Phlebitis.—The form that occurs in the early eruptive period and which chiefly attacks the superficial veins, requires the administration of mercury. The nodular variety, which occurs later in the course of the disease, is best treated by iodide of potassium. No local applications are needed.

Thrombosis is frequently met with during convalescence from **typhoid fever**, and is not uncommon in other conditions of exhaustion, such as result from prolonged or serious illness, and in the late stages of phthisis. In these cases stimulants should be given to aid the circulation, and citric acid (30-gr. doses) to lessen the coagulability of the blood, and all the milk taken should be decalcified by citrate of soda.

In **chlorotic thrombosis**, besides the administration of iron, every effort should be made to place the patient in sunshine and fresh air. The inhalation of oxygen is useful, especially in the cases of thrombosis of the cerebral sinuses so often occurring in connection with chlorosis and exhausting disease.

Thrombosis of the portal vein, if acute, will give rise to ascites probably demanding paracentesis, which may need to be frequently repeated. If the patient survives, a great development of the superficial abdominal veins occurs, fluid accumulates less rapidly, and eventually no further tapping is required.

Thrombosis of the prostatic veins may be accompanied by swelling of the gland sufficient to cause difficult micturition, in which case a soft rubber catheter must be used to relieve the bladder. Prostatic abscess not unfrequently follows and should be opened as soon as detected.

Thrombosis of the corpus cavernosum may be associated with syphilis, and should be treated by gentle inunction of mercurial ointment locally and by the appropriate constitutional remedies. If met with in a gouty subject, salines, aperients and iodide of potassium will be indicated.

The dilated veins constituting **venous hæmorrhoids** are very prone to become thrombosed, especially when protruded through the sphincter. For these the simplest plan is to incise the tumour, turn out the clot and ligature the vein. The clot if left is liable to the invasion of micro-organisms, and by its extension is apt to lead to the formation of ischio-rectal abscess.

The organisation of **thrombus in varicose veins** is usually very slow; it may lead to obliteration of the varix; but when thrombosis occurs in cysts and tortuous dilatations, especially in veins near the knee or in the long saphenous in the thigh, the safest course is to ligature the vein and excise the thrombosed portion. When thrombosis is spreading along a varicose vein, or in the saphena above the varicose portion, the vein should be divided between two ligatures above the point to which the thrombus has extended.

After a severe attack of phlebitis, especially if the large venous trunks have been involved, some of the affected veins will probably be more or less obstructed. For the treatment of this condition it is necessary to bear in mind the changes that are occurring in the vessels, for upon its right management will often depend much of the future comfort and activity of the patient.

The lumen of the vein may be completely filled by blood clot which, becoming gradually organised, obliterates the canal and converts the vein into a solid cord; or the clot may be tunnelled and a channel for the blood remain either through the thrombus or between it and the wall of the vein. In non-infective phlebitis or thrombosis, the outer coat of the vein is not materially thickened, and the diminished lumen of the vessel depends upon the organisation and contraction of the adherent clot. But in phlebitis originating in an infective focus or wound the outer coat is always much infiltrated, and may be left permanently thickened and indurated. In this way, and by subsequent contraction, the lumen of the vessel is encroached upon and much diminished, and this may be still further narrowed by the addition of organised clot from within.

When a main venous trunk such as the femoral or iliac is permanently blocked, certain changes result in the limb concerned. As an example, let the case be one in which the femoral and external iliac veins are obliterated. At first, whenever the limb is dependent or the upright posture is assumed, the veins, both superficial and deep, become full; the limb becomes painful, tense and somewhat swollen; and a sense of constriction is felt at the groin and in the popliteal space. The skin presents a dusky, congested appearance; the muscular power is diminished; and after walking a short distance severe aching pain occurs which makes a rest imperative. If the patient is now placed recumbent and the limb elevated, the veins gradually become less full, the skin recovers its normal colour, and the pain subsides; but the limb remains somewhat larger and firmer than its healthy fellow and the contraction of the superficial muscles is less easily seen. The collateral venous circulation begins to develop almost immediately upon the blocking of the main trunk, and in the course of a month or six weeks some enlargement of the superficial veins at the groin and lower part of the abdominal wall becomes manifest. This goes on gradually increasing, and at the same time the deep communicating veins are enlarging; and as the collateral circulation becomes developed, the upright posture causes less congestion and swelling, walking is less painful, and the limb recovers more quickly when rested. But the enlarged superficial veins, although assisting the return of the blood, are themselves the cause of much local discomfort; their distension gives rise to painful aching, and their prominence and lack of support render them liable to injury. It is therefore desirable in all cases in which a main venous trunk is blocked to favour as far as possible the development of the deep collateral vessels and to prevent the excessive enlargement of the superficial veins. It will be remembered that the return of the blood through the deep veins is assisted by muscular contraction, which has but little effect upon the veins of the surface, and that the deep veins, having the support and protection of the tissues among which they are placed, do not become easily over-distended or varicose and are not liable to injury.

Evidently, therefore, it is to be desired that the collateral circulation should depend as much as possible upon the deep veins and as little as possible upon those of the surface. This is a matter of considerable importance, and a good deal can be done in the direction indicated. In the first place, it is necessary to decide *at what period the use of the limb may safely be attempted.* This requires careful consideration, for while on the one hand there is the danger of displacement of clot if the limb is used too soon, on the other hand the functional activity of the muscles is the best aid towards the development of the deep collateral veins.

Pulmonary embolism is not common after the sixth week from the formation of a thrombus, although instances have been recorded of the detachment of a clot by a blow or pressure at later periods. There are great variations in the time required for the organisation of thrombi. It must be borne in mind that this process is really the invasion of the thrombus by active cells and new vessels and the gradual replacement of the blood clot by connective tissue. This change needs for its favourable progress the functional activity of the venous wall, and is inevitably delayed by the presence of septic organisms. In simple non-infective cases evidence of commencing organisation may be found in a thrombus at the end of a week, whereas in veins the walls of which have undergone degeneration very little change may have occurred at the end of a month.

In an uncomplicated case of phlebitis it will usually be safe at the end of six weeks from the last extension of the thrombus to commence some movement of the limb, but this should not be permitted as long as there is any tenderness over the vein, for tenderness implies the possibility of further extension of thrombus. The first movements should be those of gentle passive flexion and extension; then, after a week, the patient may begin to move the limb slightly himself, avoiding marked flexion of the joint beneath the thrombus and gradually increasing the muscular activity. By the fourth week after commencing movement, if all goes well, he may be allowed to get up and to walk a short distance, the limb being kept raised in the interval and care being taken to avoid any interference with the circulation by tight clothing or otherwise. If the vein is not blocked, no bandage or elastic stocking should be worn.

In cases of septic origin, and also in those in which there is serious disease or degeneration of the veins, a longer time should be allowed before movement.

When in an uncomplicated case of phlebitis the clot has undergone early and rapid disintegration and the blood current through the vein can be felt to be re-established, movement may be allowed at an earlier period, and may be cautiously commenced when the vein is entirely free from pain and tenderness.

When a large trunk, such as the femoral or iliac vein, becomes permanently blocked, many small superficial veins are developed, which not infrequently become inflamed in consequence of some local irritation. A little tenderness is felt on some part of the skin, and on careful inspection a narrow branching line of slight redness is seen, under which is felt the soft cord of a minute blocked vein. If the limb is kept raised and quiet for a few days, and the tender vein covered with a warm lotion of boric acid or lead, or painted over with the oxide of zinc lotion described above, the little vein usually soon becomes again pervious, the tenderness and redness subside and the trouble is at an end; but if the condition is neglected, the phlebitis may spread to larger veins, or other small branches may become involved and a troublesome area of inflamed skin is left, causing much irritation and annoyance. When the patient first begins to walk, a soft *elastic bandage* should be gently applied from the foot to the groin and carried in a figure-of-eight round the iliac region of the abdomen, the skin having been first dusted with powdered boracic acid. The upright posture should be maintained only for a very short time at first, a walk of about ten minutes will cause the limb to become painfully congested and necessitate a rest in the recumbent posture with the limb well raised. Standing should be avoided as much as possible, but the *exercise of the muscles* should be gradually increased as the collateral venous circulation is developed. If all goes well, and if the blocked vein is quite free from tenderness, *massage* may be commenced after about three months. This should consist of gentle rubbing in an upward direction, the actual course of the blocked vein being avoided and the limb dusted freely with boracic acid. It should be done in the evening after a warm bath, and no exercise should be taken afterwards. The foot of the bed should be raised on blocks 6 inches in height.

As more use of the limb becomes possible, it will be best to substitute for the bandage a well-fitting *elastic stocking.* If the vein is not blocked above the popliteal region the stocking need only cover the leg. If the obstruction is in or above the femoral vein the stocking should be in two pieces, the lower reaching from the foot to just below the knee, the thigh-piece from below the knee to the fold of the groin, with a peak ending in a strap for attachment to braces.

If the obstruction extends much above Poupart's ligament, to the iliac veins or the vena cava, a combined thigh-piece and abdominal belt should be worn, and this should be adopted from the beginning so as to prevent, as far as possible, the enormous dilatation of the superficial collateral veins at the groin and iliac region, which will otherwise take place. Probably no care will prevent considerable enlargement of these veins, and when they are very prominent comfort may be given by introducing a soft graduated pad over them and beneath the belt. Whichever part of the venous trunk is obstructed it is a mistake to delay the application of the elastic support till the superficial veins begin to dilate; every effort should be made from the first to encourage the return of the blood by the deeper branches.

In most cases the thigh-piece can be discarded after four or five years, but in some instances the great development of the collateral veins of the iliac region necessitates continued support and protection.

Great care should be taken to *avoid all constriction of the limb.* Elastic stockings are often made with a tight band at the upper limit, which acts like a garter. This is harmful and unnecessary, for if the stocking is made to measure and fits well it will keep in place without any such addition. Shoes are better than boots, and knickerbockers fastened round the knee must not be worn. Exercise should be taken in the early part of the day and the patient should be instructed to take every opportunity of keeping the limb raised, especially towards the end of the day. In the evening, and when no more walking or standing is to be undertaken, the bandage or stocking may with advantage be discarded. Hard seats, especially chairs with a hard rim at the front of the seat, should be avoided, and a footstool used, so as slightly to raise the under-surface of the thigh from the chair. It is astonishing how small an amount of pressure will obstruct the venous circulation, especially where it depends largely upon the superficial veins; the weight of the arm resting upon the thigh, the weight of the leg, if crossed over the opposite limb, is sufficient seriously to impede the venous return.

Special care should be taken to avoid constipation or any cause of abdominal distension, by either of which the venous discomfort is markedly increased.

Towards the end of the day, especially if there has been much standing, the limb will become somewhat swollen, heavy and congested, and this is often accompanied by a good deal of aching, itching and discomfort. The best remedy for this is a thoroughly hot bath, followed by gentle massage with the limb raised.

Among the remoter troubles resulting from blocked crural veins is the development of a plexus of small tortuous veins between the inner ankle and the heel; this leads to a condition of irritation and malnutrition of the skin, which may even go on to ulceration. When these veins begin to appear, a thin pad of lint or felt may with advantage be introduced under the stocking, behind the inner malleolus, and when signs of irritation of the skin are observed the most useful application is the so-called "hazeline snow" gently rubbed over the part at night.

Groups of small, slightly raised, bright red spots on the skin, somewhat resembling psoriasis, are also met with, chiefly about the inner side of the knee and the outer side of the thigh. These spots appear usually after long standing and most commonly in cold weather; they cause much itching and burning, for which the hazeline ointment is a suitable application, and they rapidly disappear with rest. Sometimes, after much standing or prolonged walking, bright red patches appear on the legs attended by a sense of heat but not of itching. The redness disappears on slight pressure and fades gradually after a day or two of rest. These conditions are much benefited by the hot bath and by the application of the zinc lotion.

Many of the results of past phlebitis, such as have been described above, are greatly benefited by *the baths of Bagnoles de l'Orne*, in Normandy. There is certainly something more than is revealed by analysis in the natural water which is used there for the baths. This is a soft water, containing a small amount of silicate, sulphate and chloride of sodium and calcium, which issues at a temperature of 26° C. The baths are given at a temperature of between 33° and 37° C. (91° to 99° F.), the patient being immersed for thirty or forty minutes. The effect is a remarkable stimulation of the capillary circulation, a suppleness, softness and improved nutrition of the skin, and increased muscular activity. The Établissement Thermal is well arranged, there are good hotels, and the neighbouring country is charming. The season is from May 15th to October 1st. This treatment should not be undertaken until the acute stage of phlebitis is quite passed, and it is contra-indicated in patients with a tendency to pulmonary or cerebral hæmorrhage; but when adopted at the appropriate stage of convalescent chronic and recurrent cases, the good effects are most striking. Taken internally the water is decidedly diuretic and is especially beneficial to the gouty, but it is slightly constipating.

The heart, of course, has much extra work thrown upon it by venous obstruction, and when exercise is first resumed in a case of blocked vein dyspnœa is easily provoked; care must therefore be taken to put no needless strain upon the heart, as by rapid walking or ascending hills. It should be remembered that if the resistance in the vessels is such as the heart can overcome, hypertrophy of the heart takes place to meet the increased resistance, but that if the resistance is greater than the heart can overcome, dilatation of the heart results. But gentle exercise is good, and sunlight and pure air are very beneficial, for the better the oxygenation of the blood the more easily it circulates and the less is the fatigue of muscular action. Moreover, the more thoroughly the blood is oxygenated the less prone is it to thrombosis.

The sufferer from blocked veins who wishes to reduce the inconvenience to a minimum must live temperately on light diet, be careful to avoid constipation or fæcal accumulation, take moderate exercise early in the day and rest in the evening, avoid hurried, severe or prolonged exertion, clothe warmly but lightly, keep out of hot and ill-ventilated rooms, breathe pure air and seek the sun.

Arterial Thrombosis.—The treatment of arterial thrombosis must be chiefly directed to favouring the development of the collateral circulation. The affected limb must be kept at rest, and the temperature of the body maintained by light warm clothing, and that of the limb by wrapping it in Gamgee tissue. Food and stimulants should be carefully administered, and the patient kept as much as possible in fresh air and sunshine. Syphilitic or other arterial disease must be looked for and treated, as also must be disease of the heart or causes of exhaustion.

Senile gangrene, which often depends upon thrombosis of the small terminal arteries, may sometimes be averted if the condition of the arteries is detected at once, as it generally may be by the acute pain suffered. The feet should be enclosed in thick, loose, knitted woollen socks, and kept on soft pillows raising them slightly from the bed. Several times a day the feet should be bathed in hot water and the affected toes then gently rubbed with lanoline. These measures, with rest, quiet and appropriate constitutional treatment, may lead to the re-establishment of the circulation and the safety of the foot.

J. WARRINGTON HAWARD.

DISEASES OF LYMPHATIC GLANDS AND VESSELS.

DISEASES OF THE LYMPHATIC GLANDS.

The lymphatic system differs so materially from any other structures of the body in that its lesions, with few exceptions, are secondary, that it is necessary to treat this system on lines essentially its own.

Primary disease of this system is so rarely met with in this country, as compared with tropical countries, that on a case presenting itself for treatment, great care should be directed to the discovery of a lesion in some organ or part, the lymphatics of which drain into neighbouring glands.

Of all the superficial regions of the body where lymphatic glands are to be found enlarged, the result of some disease, the anterior and posterior triangles of the neck supply the most frequent examples.

DISEASES SECONDARY TO INFECTIVE PROCESSES.

The attention of the practitioner should be directed to the lesions which most commonly give rise to enlargement of the glands, such, for example, as unhealthy tonsils, ulcers of the naso-pharynx, foul teeth, dental caries with unhealthy gums, lesions of the scalp, occasioned either by macroscopic life (pediculi) or by infective organisms, the most common being some strain of staphylococcus (impetigo contagiosa), lesions of the tongue and buccal cavity, lesions of the eyelids or of the lacrymal sac, an eczema of the external auditory meatus occasioned by a chronic ear discharge, and all forms of stomatitis in children.

It is some such lesion or a combination of such lesions which cause the glands to become swollen, painful and tender; therefore it is essential that careful search should be made for the primary lesion. In the first place, syphilis and the acute infective diseases, such as measles, diphtheria, and scarlet fever, should be excluded. Syphilis is easily eliminated, as the glands are small and shotty and occur in both triangles of the neck, and in addition, the other classical signs will quickly furnish the desired clue.

The common lesions of the buccal cavity are best treated by mouth washes, and the ones which have stood the test of trial are: (1) Solution of permanganate of potash (1 in 25 of the liquor) [U.S.P. 1 in 2,500] which, diluted with hot water (equal parts) makes a most efficient and cleansing wash: (2) A lotion composed of the following ingredients: Pot. Chlor., gr. 5; Alum., gr. 4; Glycerin., q.s.; Lot. Acid. Carb., 1 per cent. ad ℥j; made pleasantly warm by the addition of hot water: (3) A warm 1 in 4,000 solution of biniodide of mercury: (4) Warm boracic lotion with a little glycerine added: (5) Formaldehyde tablets are also most useful in cleansing the mouth.

A word of advice as to the method of using such mouth washes will not be out of place. Let it be remembered that to get the maximum amount of good out of them they should be held in the mouth for one minute, as timed by a watch, and that this should be repeated three times on each occasion that their application is ordered. It is of very little use to rinse the mouth out in a casual fashion and to expect a rapid subsidence of the local condition. In small children where this is impossible, it is better to substitute the method of swabbing. Before using any of the above lotions be sure that the mouth has been well rinsed out with warm water or warm bicarbonate of soda solution.

There can be little doubt that by far the greater number of cases of swelling of the lymph glands which present themselves for treatment are, in the first instance, cases due to the toxin of staphylococci, etc., and readily yield to treatment if the primary source of infection is carefully searched for and treated energetically.

Should the swollen gland not then show signs of diminishing in size, but remain more or less enlarged, one is justified in being suspicious of tuberculous adenitis.

ARTHUR CONNELL.

HODGKIN'S DISEASE (LYMPHADENOMA).

Hodgkin's Disease, or lymphadenoma, is characterised by a general and progressive enlargement of one or more groups of lymphatic glands. The spleen is frequently enlarged as well and there may be a simple anæmia. Lymphadenoid growths may develop in various organs, especially the spleen and liver. We are as yet in complete ignorance of the cause of Hodgkin's disease. It is, however, probable that it is due to a chronic infection, the nature of which has yet to be discovered.

General Treatment.—The general treatment must in the first place be directed to the removal of any local source of irritation or infection which may influence the infected glands and to the maintenance of the general health and resistance of the patient at a high level. The mouth should be carefully examined and any carious tooth which might be a source of oral sepsis must be removed. Any local disease of the nose, throat, ears or skin must also be suitably treated. The general mode of life should be such as to enable the patient to spend a good deal of time in the open-air.

Moderate exercise without fatigue in the earlier stages of the disease is beneficial, but all mental or bodily strain and all excess is to be avoided. No special diet appears to influence the course of the disease, and in chronic cases it requires no special modification. If there is fever the diet must be arranged accordingly, and if there is emaciation milk should be taken to the extent of 2 or 3 pints in the day.

Surgical Treatment.—When a single group of superficial glands in the neck, axilla or groin alone is enlarged and there is no distinct constitutional disturbance, it is probable that the disease is still localised. Under these circumstances the glands should be removed, and recorded cases show that there may be no recurrence of the disease for as long as six or seven years after the operation. If there is fever, marked leucocytosis or reduction of the number of red blood corpuscles below 60 per cent., the disease is probably generalised and little or no advantage will be gained by the removal of one group of glands. If in any case the glands become sufficiently enlarged so as to compress or displace the nerves, blood-vessels or trachea, or to be unsightly or inconvenient, excision may be recommended, in order to relieve pressure, although the general course of the disease may not be materially affected by the operation. It will be found, however, that when X-ray treatment is applied in the early stages of the disease the glands will rarely reach such a size as to require removal for this purpose. No attempt should be made to remove either deeply seated glands or an enlarged spleen.

X-ray Treatment.—In the application of X-rays we have a most valuable means of controlling the enlargement of the lymphatic glands and the development of lymphadenomatous growths in the internal organs. Dr. A. E. Barclay has kindly furnished me with some technical details of the treatment as it is employed in the electrical department of the Manchester Royal Infirmary. The current employed is obtained from a coil. One Sabouraud dose (= 5 Holzknecht units) is given at a time through a filter consisting of four layers of boiler felt. Rather a high vacuum, of about 6 on the Benoist scale, is employed, a current of 1 milliampère passing through the tube. The X-rays are applied in this manner for ten minutes two or three times a week to each group of enlarged glands in turn, and also over the spleen and liver if any affection of these organs is detected. If the mediastinal or abdominal glands are enlarged they should also be exposed to the action of the rays from the nearest point on the surface of the body. The duration and frequency of the sittings must be regulated according to the effects on the glands and the skin overlying them. As a rule, it is a good plan to repeat the treatment as often as is possible without injuring the skin or affecting the general condition of the patient, so as to bring about a gradual reduction in the size of the glands and to check the growth of any fresh glands which become affected. By changing the point at which the rays are applied dermatitis may be avoided. By this means a remarkable reduction in the size of the superficial glands can be brought about, some of them returning almost to their normal size.

In two of my cases, in which the mediastinal glands had been sufficiently enlarged to compress one bronchus and cause great diminution of air entry into one lung with dyspnœa, the reduction in the size of the glands was sufficient to permit of free entrance of air again with marked relief of the patient. In a similar manner the spleen diminishes in size and the general condition of the patient improves, so that life may be, not only tolerable, but even enjoyable.

It is well to point out, however, at the commencement of the treatment that the effects are not permanent and that the improved condition can only be maintained by the continued use of X-rays once or twice in a fortnight. If the treatment is discontinued for more than a week or two at a time the glands begin to enlarge again. By the continued use of the X-rays the internal pressure by the enlarged glands can be kept in check and life may be enjoyed for a year or eighteen months longer than would otherwise be possible.

Many other methods of local treatment have been advocated, among which may be mentioned the injection of arsenic, iodine and other drugs into the enlarged glands, galvano-puncture, massage, hot and cold douches, mercurial inunction, counter-irritation and blistering of the skin over the glands. None of these methods of treatment are of real benefit and some may cause the patient a good deal of discomfort if not actual pain.

Medicinal Treatment.—Arsenic is, on the whole, the most useful drug in the treatment of Hodgkin's disease. It is most conveniently given in the form of Fowler's solution, of which 5 min. may be given three times a day in water or milk after meals. The dose may be gradually increased up to 15 or even 20 min., provided no symptoms of intolerance are set up. It is advisable to omit the arsenic for a few days every three or four weeks. In some cases the enlargement of the glands is markedly diminished and in a few it has even disappeared. The best results appear to be obtained by the combined use of arsenic and X-rays. Though frequently used, the iodides have little effect upon the disease. In isolated cases phosphorus and sodium tungstate have been of service.

GEORGE R. MURRAY.

TUBERCULOUS DISEASE OF THE LYMPHATIC GLANDS.

In the majority of instances the tubercle bacillus gains its entrance to the glands by means of an unhealthy mouth, and especially an unhealthy tonsil. In all cases, therefore, an important part of treatment is the disinfection of the mouth and tonsil, and, if necessary, the removal of the latter. Too much stress cannot be laid on the importance of arriving at a diagnosis in an early stage of the disease. The responsibility of the profession in tuberculous affections is great, for the simple reason that an early diagnosis often means the difference between comparatively rapid recovery of health on the one hand, and prolonged suffering and in some cases lifelong misery on the other.

When we have satisfied ourselves by definite evidence that we are dealing with tuberculous glands which have not broken down, our main dependence must be upon the scientific use of tuberculin. At the same time we cannot afford to depend wholly on tuberculin. Those who trust to the effect of nature, and especially to the effect of the air at such places as Margate and Ramsgate, obtain a number of satisfactory results, but in many instances the reward of this form of treatment is prolonged ill-health, coupled with unsightly scars or even disaster. Those who trust wholly, or almost wholly, to the effect of tuberculin, whether its administration is controlled by purely clinical indications or by frequent determinations of the opsonic index or both, also obtain a number, possibly a larger number, of satisfactory results; but here, again, in many instances the results are often disappointing and sometimes disastrous. The same may be said of those who trust wholly, or almost wholly, to surgical procedure, or to the use of Röntgen rays. It is an established fact that natural methods of repair, the use of tuberculin or of Röntgen rays, or the adoption of surgical measures all do good, but that each one of these when employed by itself alone frequently fails. Far better results will be obtained in future by an intelligent use of these methods side by side in an individual case. The clinician cannot afford to neglect the use of tuberculin or of Röntgen rays, or methods which are similar in their action. Nor can the bacteriologist afford to disregard the ordinary and established lessons of clinical observation. Certainly the bacteriological therapeutist cannot afford to trust entirely to the effects of tuberculin or be guided entirely by his opsonic readings; he cannot afford to neglect nature, for though we may assist nature and even guide her, we cannot afford to despise her. The surgeon at the present time is a necessary evil so far as tuberculous glands are concerned; but when the condition is diagnosed in an early stage, and treatment carried out efficiently on modern lines, the surgeons will have less to do in this direction.

Before any case of apparent glandular tuberculosis is treated a thorough examination of the patient should be made. Tuberculosis of the external glands is frequently associated with other tuberculous manifestations, and if we do not investigate each case thoroughly before commencing treatment, the line of treatment adopted may be wrong and the result unsatisfactory. One case of several which have come under my notice will serve to emphasise the importance of this point. A young woman sought the advice of a bacteriologist for a considerable enlargement of the cervical glands. The clinical investigation was confined entirely to the swelling, and no examination was made of the lungs. The diagnosis of tuberculosis was made by the blood test. A course of tuberculin was given for some months. The opsonic curve obtained was said to be satisfactory, as it was always above the normal limits. No local improvement followed, and gradually the patient became very ill. When she left the bacteriologist and came under my care at St. George's Hospital she was suffering from extensive disease of both lungs, and had high fever. The case was now a hopeless one, and ended fatally. I have little doubt that if the first examination had been thorough, or if even the temperature record had been taken, this woman's life would probably not have been sacrificed. The fact that the opsonic index was nearly always above normal misled the bacteriologist, who was trusting to one control, and one only.

General Measures.—A child suffering from glandular tuberculosis should be placed under the best possible natural conditions. Fresh air, especially sea air, good food, and the avoidance of fatigue are necessary to raise his natural resistance. Measures like these, as is known to all clinical observers, greatly enhance the value of vaccine therapy. In all cases the temperature record should be carefully kept. If fever is present the child should be kept at rest until the temperature has become normal.

Secondly, in any case of glandular tuberculosis it is important to *avoid all sources of irritation.* I have seen several cases in which the omission of this precaution has led to disappointing results from the administration of tuberculin in the hands of highly competent bacteriologists. In two cases of glandular tuberculosis of the neck, tuberculin had been given for as long a period as fourteen months without improvement at the time I was consulted. In both cases there were a number of carious teeth in the lower jaw, the presence of which had been overlooked. When these received proper attention, and the source of irritation had been removed, improvement at once followed the further administration of tuberculin. In another case a tight elastic hat-band beneath the chin kept up a chronic irritation which prevented improvement; in another the clothes round the neck were so tightly fastened that the glands were constantly irritated; in another the presence of pediculi had been overlooked. All such forms of irritation should be avoided if we are to obtain the best results in a reasonable time. In cases in which the cervical glands are involved, the condition of the mouth should be ascertained and strict cleanliness maintained. It is particularly necessary that *undue* movement of the glands should be avoided, as it leads to excessive auto-inoculation, and so militates against an efficient response by the immunising capacity of the body.

Tuberculin.—We may now turn to the subject of the administration of tuberculin. Evidence is daily accumulating to show that tuberculin properly given is a specific in tuberculous affections of the glands, and that the earlier in the history of the case it is given the quicker are satisfactory results obtained. No one who, like myself, has seen lasting cure produced by the use of tuberculin in chronic cases in which, in spite of a number of operations having been performed, constant relapses had taken place, or who has seen early cases in which the administration of tuberculin has been quickly followed by immediate and apparently permanent relief, can doubt that the efficient administration of tuberculin is to be recommended in all such cases. It must be understood that tuberculin cannot be given in any routine or haphazard fashion. To give settled doses at settled intervals without reference to the individual susceptibility and characteristics of the patient is to revert to unscientific medicine, and must, in time, bring nothing but discredit on the administrator. Tuberculin improperly given is capable of doing great harm. It is imperative, when we administer this remedy, that we should have a sufficient guide to the immunising response of the blood, so that we may know the effect of our doses, what doses we are to give, and at what intervals we are to give them.

The best and most practical guide is the close consideration of the clinical symptoms. This, and the question of the administration of tuberculin, are dealt with in Volume III. in the article on Tuberculin Therapy. It may be stated here that tuberculin should be given in all cases for at least six months to a year after signs of active disease have gone if we are to guard against relapses. This as a rule, however, will not necessitate more than one dose a month in the later stages of the treatment.

If extensive caseation of a gland has occurred, or if a discharging sinus is present, *surgical measures* have to be considered. The teaching of experience is, that when caseation to any marked degree has occurred the value of tuberculin and other means of treatment is largely negatived, and that even prolonged treatment fails to give us a satisfactory result until an outlet is provided for the necrosed products. Any surgical measures should, however, be combined with the administration of tuberculin. This should, as a rule, not be given for ten to fourteen days after an operation, owing to the auto-inoculation produced by the latter. When a discharging sinus is present it is necessary to find out whether *secondary infection* has occurred, and, if so, to administer the appropriate vaccine.

In most instances it is wise not to commence with a larger dose than $\frac{1}{100,000}$ mg. T.R., or B.E. In some cases even this small dose is sufficient to produce fever. In my experience this may be taken to mean that necrosis has already occurred. Often in such cases the gland rapidly breaks down, and when such small doses of tuberculin produce fever it is wise that an operation should be undertaken at once. Subsequently the use of tuberculin should be resumed. In such cases the eventual prognosis is good. When there is no obvious sign of necrosis and small doses of tuberculin do not cause any reaction, the careful use of this remedy, if carried out for a sufficient time in combination with the other measures already referred to, will lead to a satisfactory result, and render an operation unnecessary in the majority of cases. In very early cases the result of this treatment is sometimes extraordinarily rapid and complete: and this is an added argument for the necessity of early diagnosis and treatment. In cases in which improvement is slow, the use of remedies such as X-ray and hot sand-bags, which produce auto-inoculation, may be tried in addition; but it must be remembered that just as the dose of tuberculin requires anxious care, so does the amount of auto-inoculation prescribed.

ARTHUR LATHAM.

THE SURGICAL TREATMENT OF TUBERCULOUS GLANDS.

A REFERENCE to the work by Poirier and Cuneo will amply repay one in search of the anatomical arrangement of the cervical glands, but from the point of view of this article, it may be stated shortly that the deep cervical chain, particularly the upper nodes of this chain, is the one marked down by the tubercle bacillus. This chain, the whole of which lies under, *i.e.*, at a deeper level than, the sterno-mastoid muscle, receives the infection directly, or through the post-pharyngeal nodes, from the pharynx, the nasal and much of the oral mucous membranes. As a consequence of this anatomical distribution, it stands to reason that this is the part of the cervical region which will require surgical attention most frequently.

Operations in this region fall under two categories: (*a*) Operation of incision for a broken down and suppurating gland; (*b*) operation for extirpation of tuberculous lymph glands. It is taken for granted that the general practitioner will not launch out into the major operation of total extirpation of the glands of the neck, an extremely difficult and dangerous procedure for any except those most conversant with major operations.

Operative Procedure.—The part should be gently cleansed with warm water and ethereal soap and thoroughly shaved, then dried with some soft material and painted with a solution of iodine, either chloroform iodine or the liquor iodi.

The instruments required for either of these operations are: dissecting forceps, artery forceps (eight or ten pairs), sinus forceps, scissors (two pairs), two small blunt-hook retractors, Volkmann's spoon, needles, catgut, silkworm-gut and drainage tube.

The skin incisions best suited to the neck are the transverse incisions recommended by Kocher. They can often be planned so as to run in the natural lines of the neck and leave little scarring. Incisions made parallel with either the anterior or posterior borders of the sterno-mastoid leave large scars which are very noticeable and unsightly.

At the time of making these transverse incisions in the neck there is just one superficial structure which, if remembered and treated promptly, will save both anxiety and loss of blood; it is the external jugular vein which runs obliquely downwards and outwards across the side of the neck, following a line from the angle of the jaw to the midpoint of the clavicle, ½ inch or so above which it pierces the deep fascia to join the subclavian vein. If it is seriously in the way, do not hesitate to clamp it immediately above and below the spot it is intended to divide it and tie it at these two points. Pull the sterno-mastoid outwards, or if more room is required, divide it at right angles to its long fibres and turn it upwards and downwards; be careful to suture it with catgut before closing the superficial wound, and in the act of dividing be sure to avoid dividing the spinal accessory nerve which reaches the anterior border of the muscle about 1 inch below the tip of the mastoid process, and passing obliquely downwards and outwards emerges from under the cover of the muscle about the middle of its posterior border.

After removal of the glands see that all oozing of blood has ceased before any attempt at closure of the wound is undertaken. It is safer to leave in the cavity a small portion of small drainage tube, which is easily fixed to the edge of the wound by passing a needle, carrying a suture, through one side of the tube, bringing it through the skin and tying off. This tube, as a rule, can be removed in twenty-four or thirty-six hours without giving any inconvenience to the patient. An ample moist dressing, in cases of suppurating glands, changed every four or six hours, or in the case of excised glands, a dry sterile or antiseptic dressing, is all that is required. The dry dressing and the fine drainage tube should be removed in thirty-six hours, after which the dressing can remain *in situ*, for a week or ten days, when the stitches will be ready for removal.

On the other hand, when cases of tuberculous adenitis are brought early for treatment one is in a much happier position armed with tuberculin and X-rays,[1] coupled with general treatment, such as sunshine, fresh air and sound, wholesome food. Methods of treatment which should be avoided are painting with iodine and the rubbing of the swollen glands with any kind of lotion or ointment, a practice which I think is indulged in far too frequently, owing to a lack of appreciation of the true pathological processes going on within the glands.

Another important point which I would call attention to is the habit of clothing the neck too warmly. When a case is brought for opinion be careful to note the number of neck-wraps, red flannel bands, and, in the case of the female sex the character of the neck-band attached to the dress or bodice.

When summing up the practitioner will be well advised to caution parents on the harm done by such neck attire, for very often it serves as a true indication of the poisoned atmosphere in which the patient is living at home, with closed windows and a dread of fresh air in the house, fostered by that appalling bogey "Draught."

ARTHUR CONNELL.

REFERENCE.

[1] Medical Press, 1909, CXXXVIII., p. 351.

NEW GROWTHS OF LYMPHATIC GLANDS.

Lymphosarcoma.—One of the most rapidly growing and fatal forms of lesion attacking the lymphatic system. No treatment of any kind has the smallest influence in checking the rapidity of the growth. Both operative measures and the administration of Coley's Fluid have been adopted for this condition, but so far the result has been most disheartening.

Carcinoma.—The lymphatic glands which have to deal with an area infected either by epithelioma or carcinoma become enlarged and very hard. Very free removal, together with the efferent channels, is most desirable and necessary.

Special attention should be paid to enlarged glands in the groin, for I have seen the primary lesion of epithelioma of the anus missed whilst the patient's anxiety was entirely fixed on the swelling in the groin.

ARTHUR CONNELL.

DISEASES AND AFFECTIONS OF THE LYMPHATIC VESSELS.

THE lesions of the lymph vessels are better spoken of as lymphangiectases, as they present almost an exact parallel to the lesions of the blood-vessels. They are divided into groups according to their pathological entity.

Simple Lymphangiectasis. — (1) *Congenital.* — Due to the presence of one or more lymphangiectatic areas in the skin, slightly prominent, which may ulcerate through and give rise to persistent weeping of lymph (*Lymphorrhœa*). They are to be found most frequently on the face or neck and occur in the neighbourhood of developmental fissures.

This condition is best treated by making an elliptical incision around the most prominent part of the tumour and thoroughly excising the lymph vessels. After careful ligation of the weeping points the wound is closed in the usual way.

(2) *Acquired.*—A condition rarely met with in other than tropical countries and due to the presence of Filaria Bancrofti, conveyed to man by several species of the culex mosquito. It is a well-recognised fact that definite obstruction in the lymph vessels takes place accompanied by overgrowth of the surrounding connective tissue and lymphœdema.

The enormous proportions assumed by the member attacked, such, for example, as the scrotum, leg, etc., is easily understood, and gives origin to the term "elephantiasis."

Cavernous Lymphangiectasis.—As the term explains it is a cavernous arrangement of lymph chambers and is met with congenitally, either in the tongue, giving rise by its enlargement to macroglossia, or in the lip to macrocheilia. On the other hand, when it occurs in the mesentery, the lymph chambers are occupied by a chylous milky fluid.

Macroglossia.—A V-shaped incision with the base towards the tip, with removal of the diseased portion of the tongue, readily restores the organ to within the limits of the mouth.

Cystic Lymphangiectasis, which is perhaps better known as **cystic hygroma**, is chiefly met with in the neck. It is composed of multiple large clear cysts lined by endothelium, seldom communicating with each other. These cystic tumours give rise to large swellings either in the submaxillary region or below the ear; they occur for the most part on one side of the neck, and are easily dissected out.

Lymphangioma proper, is occasionally met with, and is dependent on proliferation of the lymphatic endothelium. I have had two cases within the last three years occurring in young adult females.

The condition of the upper extremity, met with in some cases after removal of the breast, has been so ably described by Sampson Handley that a reference to his Hunterian Lectures, 1910, will well repay anyone in search of further information as to the pathology and treatment. The operation of lymphangioplasty, as devised by Handley, is an operation which yielded excellent results in my two cases of lymphangioma of the leg.

Lymphangitis, dependent on some infected spot, is easily diagnosed from the pink streaks stretching from the periphery toward the nearest glands, and rapidly subsides as soon as the locally infected area has been treated. The application of glycerine of belladonna with hot fomentations to the inflamed vessels quickly relieves the pain.

ARTHUR CONNELL.

REFERENCE.

Brit. Med. Journ., 1910, I., pp. 853, 922.

A SYSTEM OF TREATMENT.

INDEX.

Abano spa, III. 147
Abdomen, bandaging of, in shock, I. 97
  bullet wounds of, II. 248
  contusions of, II. 243
  diseases of, II. 190, 423
  distension of, after abdominal operations, II. 270
    evisceration in, IV. 417
    in peritonitis, II. 638
  drainage of, in puerperal sepsis, IV. 300
  examination of, in non-operative appendicitis, II. 424
  incision of, in Cæsarean section, IV. 387
  injuries of, II. 242-256
    complicating thoracic injuries, II. 248
    convalescence in, II. 244
    general considerations and rules for treatment of, II. 253
    incidence of, II. 242
    mortality from, II. 243
    operation in, II. 254
    reaction in, II. 244
    table of cases of, II. 242
  operations on. *See* Abdominal operations.
  pains in, in food fever, II. 240
  pendulous, complicating pregnancy, IV. 61
  stab wounds of, II. 253
  supports for, in gastroptosis, II. 319
  surgery of, treatment of vomiting in, I. 29
  suture of wall of, in ovariotomy, IV. 787
  tapping of, in ascites, II. 629
  wounds of, penetrating or not, treatment of, I. 565, II. 247
Abdominal belt for umbilical hernia, II. 527
  exercises in gymnastics, III. 226
  muscles, rupture of, II. 252
  operations, after-treatment, II. 262-276
    anæsthetic, vomiting after, II. 263
    anæsthetics in, III. 31
    antiseptic precautions in, I. 91
    belt worn after, II. 268
    care of bladder after, II. 264
      bowels after, II. 264
      the mouth after, II. 264
Abdominal operations (*contd.*)—
    clothing in, II. 260
    complications of, II. 269
      involving wound after, II. 272, 273
    distension complicating, II. 270
    dressings after, II. 266
    duration of confinement to bed after, II. 267
    emergency cases, II. 260
    feeding after, II. 265
    final directions to patients after, II. 268
    fixation of time for, II. 257
    flatulence after, II. 264
    insomnia after, II. 265
    intra-peritoneal hæmorrhage complicating, II. 275
    massage after, II. 268
    nervousness and, II. 260
    pain after, II. 263
    persistent vomiting complicating, II. 269
    position of patient in bed after, II. 266
    post-operative hæmatemesis after, II. 275
    preparation of alimentary canal in, II. 258
    preparation of patients for, II. 257-261
    retention of urine complicating, II. 272
    shock complicating, II. 269
    skin preparation for, II. 259
    thirst after, II. 263
    thrombosis complicating, II. 274
    uncomplicated cases in, II. 262
    visitors to patients after, II. 266
  organs, application of vibration to, III. 220
  pain complicating typhoid fever, I. 359
  supports in constipation in adults, II. 462
  wall, incised wounds of, II. 249
    sloughing of, complicating abdominal operations, II. 273
    wounds of, II. 245
      non-penetrating, II. 246
Abduction splint and pad for the shoulder, I. 776
Abel (W.), gastro-enterostomy, first performed by, II. 343

Abnormalities. *See* Malformations.
Abortion, IV. 14-22
  after-treatment of, IV. 22
  complicating pregnancy, IV. 14
  incomplete, IV. 21
  induction of, by dilatation of the cervix, IV. 437
    by rupturing the membranes, IV. 436
    by vaginal Cæsarean section, IV. 437
    in diseases of pregnancy, IV. 433
    maternal indications for, IV. 433
    methods of, IV. 436-437
  inevitable, IV. 18
  later than first twelve weeks, IV. 20
  missed, IV. 22
    retained placenta in, IV. 225
  prevention of, IV. 14
  threatened, IV. 17
Abscess, acute, surgical treatment of, I. 166-172
  alveolar, III. 1174
  ano-rectal, II. 600-606
  cavities, irrigation and scraping of, I. 175
  cerebral, following head injuries, I. 885
  complicating typhoid fever, I. 363
  drainage of, in pelvic cellulitis, IV. 848
  in appendicitis, operation in, II. 419
  in connection with tuberculous disease of the spine, I. 928-932
  in nodule of the auricle, III. 882
  in tuberculous disease of hip-joint, I. 757
  infective, of scalp, I. 888
  infra-mammary, II. 960
  intra-cranial, coma and, II. 983
  ischio-rectal, complicating pulmonary tuberculosis, I. 1156
  labial, complicating gonorrhœa, I. 229
  mammary, II. 958
    chronic, II. 962
  of areola of nipple, II. 977
  of lung, due to foreign bodies in the bronchus, I. 1061
  of the ovary, IV. 765
  of the prostate, II. 922
  peri-urethral, II. 895-896
    complicating gonorrhœa, I. 226
    in the female, IV. 870
  psoas, I. 916
  pulmonary, I. 1059
  retro-pharyngeal, III. 789-790
    in diseases of the spine, I. 916
  sublingual, II. 133
  subphrenic, II. 643-644
  supra-mammary, II. 960
  tuberculous, methods of treatment of, I. 173-176
  vaccine therapy in, III. 264
Accommodation of the eye, errors of, III. 528-542
  spasm in, III. 542
Accouchement *forcé* in podalic version, IV. 466
A.C.E. mixture as anæsthetic, III. 20

Acetabulum, fracture of, I. 607
Acetanilide, poisoning by, I. 533
Acetone, application of, to cervix
    inoperable cancer, I. 137
  in cancer of cervix, IV. 616
  preparation of skin by, I. 73
  rubbed into the skin before
    I. 84, 88
Acetonuria, II. 730
Achondroplasia, II. 1227
Achylia, atrophy of the stomach, II.
    295
  gastrica, II. 368
Acid baths, III. 137
  carbolic, antiseptic in typhoid fever,
      351, 354
    gangrene due to, I. 219
    in plague, III. 406
    in ulcer of the cornea, III. 565
    in whooping cough, I. 382
    poisoning by, I. 527
  diacetic, in the urine in diabetes
    I. 409, 417
  formation of, in diabetes, I. 423
  hydrochloric, effect in gastric
      II. 291
    in gastric neurasthenia, II. 356
    in typhoid fever, I. 355
  hydrocyanic, poisoning by, I. 530
  oxalic, poisoning by, I. 528
  oxybutyric in the urine, I. 417
  prussic, poisoning by, I. 530
  sulphurous, in typhoid fever, I. 355
  uric, solvents of, I. 436
Acidity in cancer of the stomach, II.
  in disordered digestion in the
    II. 370
Acidosis, prevention of, I. 410, 417
Acids, mineral, poisoning by, I. 526
Ackers on epidemic gangrenous
  III. 437
Acne cheloid, III. 1018
  rosacea, III. 1135, 1136
    X-rays in, III. 350
  scrofulosarum, III. 1151
  vulgaris, III. 982-990
    after-treatment of, III. 987
    general remarks on, III. 982
    lotions for, III. 984
    ointments for, III. 986
    operative treatment of, III. 983
    parasiticide applications in, III.
    powders for, III. 985
    Röntgen rays in, III. 349, 987
    scarring of skin in, III. 986
    soaps for, III. 985
    treatment of, internal, III. 987
      local, III. 983
    vaccine treatment of, III. 989
Aconite and aconitine, poisoning by, I.
Aconitine and aconite, poisoning by, I.
  in diseases of the heart, I. 1226
Acqui spa, III. 147
Acromegaly, II. 1226-1227
Acromion process, fracture of, I. 586

Actinomycosis, drugs in, I. 178
  general treatment of, I. 177
  local treatment of, I. 177
  of Fallopian tube, IV. 800
  of the gall bladder, II. 711
  of the jaws, II. 109
  of the lung, surgical treatment of, I. 1175
  of the pharynx, III. 765
  of the skull, I. 891
  of the spine, I. 919
  surgical treatment of, I. 177
Adams-Stokes' syndrome, I. 1237
Adamson (H. G.), the X-rays treatment of skin diseases, III. 341-359
Addison's disease, II. 46-48
  complicating pregnancy, IV. 50
  curative measures in, II. 46
  palliative measures in, II. 47
  symptoms of, II. 48
  (pernicious) anæmia, II. 1-12
Adductors, rupturing of by pressure with the thumb, I. 945
Adenitis complicating scarlet fever, I. 290
  tubercular, III. 757
Adenoids, anæmia and, II. 14
  causes of, I. 49
  of the pharyngeal tonsil, III. 732
  post-nasal, and Eustachian obstruction, III. 947
Adenoma, fibrous, of the breast, II. 955
  of the prostate, II. 940-949
    complication of, II. 944-946
  of the sweat glands, III. 1044
Adenomata in goître, II. 63
  sebaceum, I. 109, III. 991
Adenomatous disease of uterus, leucorrhœa in, IV. 570
Adenomyoma of uterus, IV. 662
Adhesions in acute synovitis, I. 742
  in ovariotomy, IV. 780
  pericardial, I. 1189
Adrenal glands, diseases of, II. 46-48
Adrenalin in asthma, I. 1040
  in hæmorrhage, I. 1261
  in pneumonia, I. 261
  in vomiting due to heart failure, I. 200
Adrenalin chloride in plague, III. 409
Adrenine infusion in shock, I. 98, 102
Agar-agar in constipation in adults, II. 451
Agoraphobia in psychasthenia, II. 1044
Agraphia, restoration in by functional compensation, II. 1050
Ainhum, III. 465
Air bath, compressed, in emphysema, I. 1086
    superheated, in gout and gouty conditions, I. 439
  cushion in contusions of coccyx, I. 900
  complicating labour, IV. 161-162
  embolism, I. 1306
  fresh, in pleurisy, I. 1093
    in pulmonary tuberculosis, I. 1118
  hot, therapeutical indications of, III. 324
    treatment by, III. 316-326
Air (*contd.*)—
  in chlorosis, II. 20
  vitiated, poisoning by, I. 534
Air-passages, foreign bodies in, III. 803-821
  upper, catarrh of, climate for, III. 101
Aitken (D. McCrae), surgical treatment of cerebral palsies of infancy, II. 1157-1164
Aix-les-Bains spa, III. 147
Aix-la-Chapelle spa, III. 147
Albertine on aortic aneurysm, I. 1297
Albumen water in marasmus, I. 465
  preparation of, I. 42
  in mercurial poisoning, I. 530
  in typhoid fever, I. 342
Albuminuria, II. 733
  complicating diphtheria, I. 201
    pregnancy, IV. 30-33
    pulmonary tuberculosis, II. 1157
  in acute nephritis, II. 797
  in pregnancy, IV. 7
  in scarlet fever, I. 292
  mineral waters and baths in, III. 140
Albumosuria, II. 733
Alcock's apparatus for anæsthetics, III. 14
Alcohol as sterilising agent, I. 72-73
  coma from, II. 984
  in chronic congestion of the lungs, I. 1079
  in diabetes mellitus, I. 423
  in dietary of children, I. 62
  in fevers, directions for, I. 158
  in gout, I. 456
  in heart failure, I. 193-200
  in infantile weakness, I. 66
  in influenza, I. 234
  in insomnia, II. 985
  in marasmus, I. 466
  in pneumonia, I. 260
  in pruritus, III. 1098
  injection of into nerve trunks, I. 135
    in trigeminal neuralgia, II. 1117
  intoxication by, in epilepsy, II. 993
  natural resistance to disease lowered by, I. 5, 9
  neuritis from, II. 1134
  poisoning by, acute, I. 495
  tolerance of, I. 499, 539
  use of, and anæsthetics, III. 22
Alcoholic gastritis, I. 495-498, II. 353
Alcoholism, I. 495-502
  acute, I. 495
  chronic, I. 496
    complicating cancer of the breast, II. 966
    inebriety of, I. 499
  delirium tremens in, I. 499
  dipsomania, I. 497
  drugs in, I. 495-497, 500
  gastric complications in, I. 495-498, II. 353
  hypnotic treatment in. I. 498
  nervous disturbance in, I. 496 ; II. 1134

Alder leaves in cancer, I. 149
Alexander's operation in retroflexion of the uterus, IV. 681
Alimentary canal, catarrh of, in children, I. 46
    injuries of, 250
    preparation of in operations, II. 258
  system, cancer of, relief of obstruction in, I. 139
  tract, care of, in gout, I. 450
    diseases of, II. 190
    perversion of functions of in epilepsy, II. 1018
Alkali, exhibition of in diabetes, I. 410, 418
Alkalies, caustic, poisoning by, I. 527
  in diabetes mellitus, I. 423
  in psoriasis, III. 1114
  value of, in gastric derangements in children, I. 65
Alkaline waters, III. 119
    in chronic gastritis, II. 351
Alkaloids in constipation in adults, II. 446
Alkaptonuria, II. 734
Aloes in constipation in adults, 447
Alopecia, III. 992-1004
  dependent on morbid conditions of hair follicles, III. 1000
    on the scalp, III. 1000
  symptomatic of general diseases, III. 999
Alopecia areata, III. 992-997
  general remarks, III. 992
  general treatment of, III. 993
  local treatment of, III. 994
  physical remedies in, III. 996
Alopecia cicatrisata, III. 997
  congenitalis, III. 997
  hereditaria præmatura, III. 998
  neurotica, III. 998
  pityrodes, III. 1003
  seborrhoic dermatitis, III. 1004
    oily type of, III. 1003
    or calvities, III. 1001
  senilis, III. 998
Alum, powdered, in hæmorrhage, I. 1261
Aluminium plate in fractures of jaws, II. 114
Alveolar abscess, III. 1174
  chronic, III. 1175
  echinococcus disease, III. 523
Amaurotic family idiocy, II. 1244
Amblyopia, III. 543-546
  congenital, III. 543
  toxic, III. 543
Amblyoscope, Worth's, in strabismus, III. 652
Amelies-les-Bains spa, III. 147
Amenorrhœa, IV. 725-735
  constipation in, IV. 726
  drugs in, IV. 727-728
  primary, permanent, IV. 730
    temporary, IV. 725
  secondary, IV. 731
    lactation in, IV. 731
Ammonia, acetate of, in whooping cough, I. 380
  poisoning by, I. 527
Ammonium, benzoate of, in arterio-sclerosis, I. 1294
  hippurate of, in arterio-sclerosis, I. 1294
  tartrate in opacity of the cornea, III. 572
Amœbic hepatitis, II. 676
Ampulla of Vater, cancer of, II. 714
Amputations, I. 789-872
  at the elbow-joint, I. 820-824
  at the knee-joint, I. 859-861
  at the wrist-joint, I. 813-816
  by a racket incision, I. 796
  by flaps of skin and muscle, I. 796
  by the circular method, I. 794, 795
  conditions essential for good flaps in, I. 792
  control of hæmorrhage in, I. 798
  dangers and complications after, I. 803
  Farabœuf's, I. 855, 858
  for gunshot fracture, I. 562
  for inflammatory condition, including gangrene, I. 790
  for new growths, I. 791
  general considerations, I. 789
  Guyon's, I. 850
  in acute suppurative synovitis, I. 744
  in aneurysm, I. 1303
  in disease of the ankle and tarsus, I. 774
  in gangrene, I. 214-217
  instruments for, I. 799
  interscapulo thoracic, I. 830
  in traumatic cases, I. 789
  in uncontrollable hæmorrhage, I. 559
  irregular forms of, I. 797
  Lord Lister's, I. 852
  modified circular, I. 795
  neuromata, I. 112
  of fingers, sites for, I. 804
  of the fingers, I. 804-813
  of the foot, I. 836-850
  of the knee-joint in tuberculous disease, I. 771
  of the toes, I. 834-836
  osteo-periosteal method of, I. 801
  periosteum in, I. 800
  Pirogoff's, I. 848
  Stokes's, I. 863
  stump, pain in, I. 792
  Teale's, I. 851
  technique in, I. 797
  through the arm, 824-827
    forearm, I. 816-820
  through the leg, I. 850-859
    the thigh, I. 862-866
  vitality of flaps in, I. 791
Amyl nitrite in asthma, I. 1039
  in hæmothorax, I. 564
Amylic alcohol in inoperable cancer, 137
Amyotonea congenita, II. 1245

- **Anæmia**, acute rheumatism in, I. 15
  - Addison's (pernicious), II. 1-12
  - and abdominal operations, II. 258
  - and hæmorrhoids, II. 616
    - aplastic, II. 37
  - associated with ulceration, I. 372
    - Bright's disease and, II. 17
  - cancer in, II. 16
  - caused by pulmonary tuberculosis, II. 13
  - climate for, III. 92
  - complicating tuberculosus peritonitis, II. 646
  - convalescence from, II. 15
  - due to actual loss of blood, II. 18-19
  - due to some definite malady, II. 13-17
  - heart disease in, II. 15
  - in ailing children, II. 14
  - in pulmonary tuberculosis, I. 1149
  - in rheumatism in childhood, I. 279
  - intestinal parasites and, II. 15
  - mineral waters and baths in, III. 143
  - of the labyrinth, III. 967
  - of the larynx, III. 822
  - oxygen inhalations in, II. 9
  - pernicious, anti-streptococcus serum in, II. 8
    - arsenical waters in, II. 5
    - bone-marrow in, II. 9
    - complications of, II. 10
    - convalescence in, II. 11
    - diet in, II. 2
    - drugs in, II. 3
    - gastro-intestinal antiseptics in, II. 6
    - Grawitz method in, II. 9
    - infusion in, II. 9
    - intestinal antiseptics in, II. 8
    - iron in, II. 5
    - oral antiseptics in, II. 6
    - rest in, II. 1
    - vaccine treatment of, II. 7
    - with atrophy of the stomach, II. 293
  - plumbism and, II. 16
  - septic states in, II. 16
  - severe, in post-partum hæmorrhage, IV. 222
  - syphilis and, II. 17
  - tropical, II. 15
- **Anæmic** obesity, I. 468, 472
- **Anæsthesia**, difficulties and dangers arising during, III. 33
  - general, in foreign bodies in the air passages, III. 813
  - infiltration, in treatment of cysts, I. 108
  - in relation to shock, I. 95
  - in sprains, I. 740
  - intravenous, III. 35
  - local, in foreign bodies in the air passages, III. 813
  - method of, in malignant disease of upper jaw, II. 117
    - in operations on jaws, II. 117
  - of the pharynx, III. 782
  - spinal, for relief of pain, I. 136
  - treatment of after-effects, III. 35
- **Anæsthetic**, bichlorinated chlorate of methyl as, III. 13
  - chloroform as, III. 13
  - choice of principles of, III. 21
  - in craniotomy, IV. 405
  - in decapitation, IV. 413
  - in operation for cleft palate, II. 149
  - in radical operation for cancer of breast, II. 968
  - in version, IV. 462
  - mixtures with chloroform, III. 19
  - nitrous oxide as, III. 2
  - trichlormethane as, III. 13
  - vomiting after abdominal operations, II. 263
    - complicating gynæcological surgery, IV. 489
- **Anæsthetics**, III. 1-39
  - administration of, antiseptic precautions during, I. 83
    - in certain special operations, III. 26
  - choice of, in empyema generalised in lower part of thorax, I. 1101
  - diabetes and, III. 24
  - for the reduction of dislocations, III. 33
  - general, III. 1
    - in common use and methods by which administered, III. 2
  - in abdominal operations, III. 31
  - in evisceration, IV. 416
  - in excision of the eye, III. 30
  - in exophthalmic goitre, II. 59
  - in hypertrophy of the pharyngeal tonsil, III. 734
  - in labour, IV. 376-381
    - conclusions on, IV. 380
  - in operations for cancer of the breast, III. 31
    - for empyema, III. 30
    - for intestinal obstruction, III. 32
    - for mature cataract, III. 622
    - upon the genito-urinary passages, III. 32
    - upon the rectum, III. 32
  - in perforation of the intestine, II. 551
  - local, teeth extraction under, III. 1190
  - in pregnancy, III. 24 ; IV. 58, 375-376, 489
  - teeth extraction under, III. 1190
- **Anæsthetist**, methods of, at operations, I. 83
- **Analgesia**, local, III. 38
  - spinal, III. 36
- **Anderson (Edith McC.)**, management of the sick room, I. 26-43
- **Andrews (H. Russell)**, abscess of the ovary, IV. 765
  - affections of the breasts during pregnancy and the puerperium, IV. 330-336
  - chronic ovarian pain, IV. 766
  - hernia of the ovary, IV. 767
  - intra-ligamentary tumours, IV. 768-770
  - malignant ovarian tumours, IV. 770

Andrews (**H. Russell**) (*contd.*)—
  ovarian tumours discovered during labour, IV. 773-774
    discovered during pregnancy, IV. 771-772
    discovered during puerperium, IV. 774
  ovariotomy, IV. 775-795
  prolapse of the ovary, IV. 796
  suppurating ovarian cysts, IV. 797-798
Anencephalus of newborn child, IV. 357
Aneurysm, amputation in, I. 1303
  aortic, chloroform inhalations in, I. 1299
    hæmorrhage in, I. 1300
    iodide of potassium in, I. 1298
    measures which aim at producing a cure in, I. 1297
    measures which aim at the relief of symptoms, I. 1299
    medical treatment of, I. 1297
    pain in, I. 1299
    rest in, I. 1299
    subcutaneous injection of gelatine in, I. 1298
    tracheotomy in, I. 1299
    Tufnell's treatment of, I. 1297
    venesection in, I. 1299
  arteriorrhaphy in, I. 1303
  arterio-venous, I. 1305
    of the orbit, III. 662
    of the scalp, I. 893
  cirsoid, of the scalp, I. 893
  compression in, I. 1302
  diffuse, I. 1304
  excision in, I. 1301
  femoral, I. 1304
  general treatment of, I. 1301
  gluteal, I. 1304
  intra-cranial, I. 1304
  intra-orbital, I. 1304
  introduction of foreign bodies to procure coagulation in, I. 1302
  ligature for, I. 1302
  of hepatic artery, II. 667
  of renal artery, II. 752
  popliteal, I. 1304
  sciatic, I. 1304
  simple of the scalp, I. 893
  subclavian, I. 1304
  summary of, I. 1303
  surgical treatment of, I. 1301-1305
  traumatic in gunshot wounds, I. 560
Angina, acute membranous, III. 771
  pectoris, I. 1246
    attacks of, I. 1251
    in gout and gouty conditions, I. 443
    neurosis of, I. 1252
    palpitation and, I. 1252
  streptococcus, III. 771
  Vincent's, III. 771
Angiokeratoma, III. 1151
Angioma of the auricle, III. 879
  of lingual tonsil, III. 762
  of the umbilicus in newborn child, IV. 370
Angiomata of the scalp, I. 893
Angioneurotic œdema, II. 1228-1229
Angiotripsy in hæmorrhage, I. 1257
Aniline eczema, I. 117
  poisoning by, I. 533
Animal food, II. 192
  in gout, I. 451.
  foodstuffs (Bunge), II. 745
Anisometropia, III. 528-529
  eyes used alternately in, III. 528
  one eye permanently excluded from vision in, III. 529
  simultaneous binocular vision in, III. 529
Ankle, dislocations of, I. 731
  tuberculous disease of, I. 772-775
Ankle-joint, suction glass for, in hyperæmic treatment, III. 59
  Syme's disarticulation at, I. 845
Ankylosis in gunshot injuries of joints, I. 562
  in tuberculous disease of the hip-joint, I. 761-763
  of hip-joint, osteotomy in, I. 764
  of the jaw, II. 105, 106
Ankylostomiasis, III. 487
  beta-naphthol in, III. 492
  eucalyptus in, III. 491
  prophylaxis of, III. 487
  routes of entry in, III. 489
  thymol treatment of, III. 490
Ankylostomum duodenale, expulsion of, I. 522
Annulus migrans, II. 126-129
Anodyne fomentations in acute rheumatism, I. 269
Anodynes for relief of pain, I. 134
Ano-rectal area, diseases of, II. 593-612
Anorexia and cancer of the stomach, II. 298
  nervosa neurasthenia, II. 1042
Anthelmintic treatment of tæniasis intestinal, III. 518
Anthracene purgatives in constipation in adults, II. 447
Anthrarobin in psoriasis, III. 1119
Anthrax complicating pregnancy, IV. 49
  cutaneous, I. 179
    malignant pustule, I. 179
  intestinal, I. 179
  methods of examination in, I. 180
  respiratory, I. 179
  sclavo serum in, I. 179
  treatment of, I. 179
Antibodies in serum therapy, III. 259
Anti-coli serum in bacillus coli injections, III. 271
Antidotes and poisons, I. 526-536
Antifebrin in diseases of the heart, I. 1225
Antimony, acute poisoning by, I. 529
Antimonyl tartrate in trypanosomiasis, III. 421
Anti-pneumococcus serum, III. 285
Antipyretic treatment of typhoid fever, I. 348, 351
Antipyretics, use of in pyrexia, I. 159

Antipyrin, dosage of, in children's diseases, I. 67
  in influenza, I. 234
  poisoning by, I. 533
Antirabic serum injection in rabies, I. 265
Antiscorbutics in scurvy, I. 476
Antisepsis in surgical technique, I. 84-92
Antiseptic solutions in gynæcological operations, IV. 484
  treatment of typhoid fever, I. 352
Antiseptics, composition and strength of, I. 76, 81
  definition of, I. 161
  in chronic dilatation of the stomach, II. 312
  in pernicious anæmia, II. 6
  intestinal, I. 387
    in chlorosis, II. 28
    in pernicious anæmia, II. 8
Anti-streptococcus serum, III. 290
  in cellulitis, I. 183
  in infective endocarditis, I. 205
  in pelvic cellulitis, IV. 849
  in pernicious anæmia, II. 8
  in scarlet fever, I. 288
  in septic arthritis, I. 291
Antitoxic serum in tetanus, I. 329
  therapy, III. 259
Antitoxin, intravenous injection of, dosage of, I. 191
  method of administration, I. 191
  prophylactic use of, I. 192
  treatment of diphtheria, I. 189-192
    sequelæ of, I. 193
Antitoxins in chronic rhinitis, III. 709
  in serum therapy, III. 259
Antrum, suppuration of, in acute inflammation of middle ear, III. 897
Anuria, calculous, II. 755
  complicating diphtheria, I. 201
Anus, abrasion of, in constipation in children, II. 436
  abscess of, II. 600
  artificial, in fistulæ of the intestines, II. 488
  diseases of, II. 593-625
  fissure of, II. 597
    in constipation in children, II. 436
    operative treatment for, II. 598
  fistulæ of, II. 606-610
    complications of, II. 608
    due to tuberculosis, II. 609
  imperforate, in newborn child, IV. 362
  infective ulcerative proctitis, II. 610
  ischio-rectal abscess of, II. 601
    after-treatment, II. 603
  malformations of, II. 613
  pelvi-rectal abscess of, II. 604
  pruritus of, II. 593 ; III. 1102-1105
  retro-rectal abscess of, II. 604
  subcutaneous abscess of, II. 600
  sub-mucous abscess of, II. 604
Aorta, abdominal, ligature of, for aneurysm, I. 1304
Aorta (*contd.*)—
  aneurysm of, medical treatment of, I. 1297
  thoracic, surgery of in aneurysm, I. 1303
Aperient waters, in constipation in adults, II. 466
Aperients in constipation in children, II. 437
  in prevention of lead poisoning, I. 514
Aperiosteal method of amputation, I. 801
Aphakia, III. 530
Aphasia and other speech defects of cerebral origin, II. 1143-1149
  hysterical, II. 1147
  of cerebral origin, II. 1143-1149
  speech restoration in, by functional compensation, II. 1147
  syphilitic, II. 1144
  temporary, II. 1145
Aphonia, application of vibration in, III. 219
  hysterical, III. 842
Aplastic anæmia, II. 37
Apomorphine in dipsomania, I. 497
Aponeuroses, chronic rheumatism of, I. 484
  of external oblique, division of in inguinal hernia, II. 501
Apoplexy, cerebral, II. 1070
Apparatus, surgical, sterilisation of, I. 80-83
Appendicectomy, after-care of patients from, II. 268
  incision through sheath of rectus muscle, II. 413
  muscle-splitting incision, II. 412
Appendicitis, II. 401-425
  abscess in, II. 404
    operation in, II. 419
  acute cases of, II. 402
    in children, II. 405
  and enteric fever, II. 411
  and pregnancy, II. 406 ; IV. 54
  cases of diffuse and general peritonitis and, II. 423
  chronic, II. 409
  closure of the wound in, II. 416
  desperate cases of, II. 405
  fulminating, II. 405
  in children, statistics of at St. George's Hospital, II. 406
  in elderly patients, II. 406
  indications for operation in, II. 401
  intussusception of the appendix in, II. 422
  non-operative, II. 422-425
    acute cases of, II. 423
    prophylactic treatment of, II. 424
    subacute cases of, II. 423
  operations for, II. 411
    in acute cases, II. 418
    special difficulties in, II. 417
  perforative, and Bier's treatment, III. 44

Appendicitis (*contd.*)—
quiescent appendix in, II. 407
statistics of in St. George's Hospital, II. 402
subacute cases of, II. 407
with symptoms of general peritonitis, II. 405
Appendicostomy for chronic constipation, II. 470
for chronic mucous colitis, II. 571
in constipation in adults, II. 468
in ulcerative colitis, II. 576
Appendix and tuberculous peritonitis, II. 411
dyspepsia, II. 409
in a hernial sac, II. 410
intussusception of, in appendicitis, II. 422
isolation of, II. 413
malignant disease of, II. 411
quiescent, in appendicitis, II. 407
removal of, II. 414
during laparotomy, II. 410
in quiescent stage, II. 411
when abscess is present in appendicitis, II. 421
Apraxia, II. 1150-1152
Arc light, concentrated, III. 199
use of, III. 186 ; 190
Areola, abscess of, II. 977
Argeles-Gazost spa, III. 147
Argyrol, installations of, in pyelitis, II. 804
Arm, amputation through, I. 824-830
brawny, of breast cancer, lymph-angioplasty in, I. 144
fractures of, I. 586, 596
modified circular amputation through, I. 825
Armour (Donald), abscess in connection with tuberculous disease of the spine, I. 928-932
diseases of the spine, I. 912-921
infective lesions of bones of the skull, I. 889—891
surgical diseases of the scalp and cranium, I. 888
surgical treatment of tumours of the brain, II. 1204-1207
tumours of the scalp, I. 892-896
spinal cord, II. 1221-1225
Arrowroot, preparation of, I. 42
Arsacetin in syphilis, I. 321
in trypanosomiasis, III. 421
Arsanilates in trypanosomiasis, III. 419
Arsenic, dosage of, in children's diseases, I. 68
in cerebro-spinal syphilis, II. 1067
in chlorosis, II. 27
in chorea, II. 1258
in diabetes mellitus, I. 424
in Hodgkin's disease, I. 1343
in intermittent hydrarthrosis, I. 749
in leukæmia, II. 39
in pellagra, I. 523
in pernicious anæmia, II. 3
Arsenic (*contd.*)—
in psoriasis, III. 1111
in syphilis, I. 321
tolerance of, I. 503
trisulphide of, in trypanosomiasis, III 421
Arsenical dermatitis, I. 117
neuritis, II. 1138
poisoning, acute, I. 543, 529
chronic, I. 504
waters, III. 122
in pernicious anæmia, II. 5
Arsenious acid in trypanosomiasis, III. 421
Arseniuretted hydrogen, poisoning by, I. 535
Arsenophenylglycin in trypanosomiasis, III. 418
Arterial tension, high, I. 1281
headache from, II. 1034
Arteries, compression of in hæmorrhage, I. 799
diseases and affections of, I. 1255-1308
in gouty subjects, I. 436
effect of shock on blood pressure in, I. 93
gangrene due to gradual obliteration of. I. 215
to sudden obliteration of, I. 215
gluteal, injuries to, I. 1276
hæmorrhage from, I. 1255-1277
injuries of, I. 1255-1277
intercostal, wounds of, I. 1026
lacerated wounds of, I. 1280
ligation of in gunshot wounds, I. 559
in inoperable cancer, I. 136
mesenteric, embolism by, I. 1307
palmar, wounds of, I. 1276
primary hæmorrhage of, I. 1270
sciatic, injuries to, I. 1276
senile changes of, cerebral thrombosis due to, II. 1178
subcutaneous injuries of, I. 1278
suture of, in injuries to, I. 1279
wounds of, I. 1278-1280
See also under Artery.
Arterio-capillary fibrosis, I. 1288
Arteriorrhaphy in aneurysm, I. 1303
Arterio-sclerosis, I. 1287-1295
causes of hypertension in, I. 1289
diet in, I. 1290
exercise in, I. 1291
general treatment of, I. 1290-1292
hygiene of the skin in, I. 1291
medicinal treatment of, I. 1292
œdema and hydrothorax in, I. 1294
spa treatment of, I. 1291
surgical aspects of, I. 1296
Arterio-venous aneurysm, I. 1305
communications in gunshot wounds, I. 560
Arterio-visceral-sclerosis, I. 1287
Artery, axillary, excision of, in aneurism. I. 1304
brachial, hæmorrhage from, I. 1275
femoral, injuries of, I. 1276

Artery (*contd.*)—
  frænal, rupture of, II. 876
  gangrene due to mechanical obstruction of, I. 215
  hepatic, aneurysm of, II. 667
  iliac, ligature of, for aneurysm, I. 1304
  innominate, ligature of for aneurysm, I. 1303
  internal mammary, wounds of, I. 1025
  middle meningeal, hæmorrhage from, I. 1275
  palatine, hæmorrhage from, I. 1275
  renal, aneurysm of, II. 752
  subclavian, hæmorrhage from, I. 1275
  See also under Arteries.
Arthralgia, I. 781-784
Arthrectomy in disease of the ankle and tarsus, I. 773
Arthritis, acute suppurative, I. 742-745
    general treatment of, I. 744
    local treatment of, I. 742
  adhesions of, in hemiplegia, II. 1187
  arthrotomy in, I. 745
  bursæ and cysts in association with, I. 749-750
  chronic, I. 745-748
  complicating scarlet fever, I. 290
    typhoid fever, I. 363
  deformans, I. 391-399
    climate for, I. 392
    diet in, I. 393
    electrical treatment, I. 398
    local treatment of, I. 396
    localised foci in, I. 391
    medicinal treatment of, I. 395
    surgical measures in, I. 397
    treatment by natural thermal baths, I. 397
  electro-therapeutics in, I. 746
  enteric, I. 784
  fibrolysin in, I. 748
  gonorrhœal, I. 781-783
    vaccine therapy of, III. 281
  hydro-therapeutics in, I. 745
  in hæmophilia, I. 786
  in syringomyelia, I. 786
  infective, I. 741
  local applications in, I. 748
  mineral waters and baths in, III. 142
  neuropathic, I. 785
  pneumococcal, I. 783-784
  rheumatoid, chronic rheumatism and, I. 483
    complicating pregnancy, IV. 57
    massage in, III. 208
    treatment of by counter irritation of the spine, I. 405-407
Arthrotomy in chronic synovitis and arthritis, I. 745
Ascariasis, III. 493
  prophylaxis of, III. 493
  santonin in, III. 494
Ascites, II. 626-631
  cardiac, II. 630
  complicating pregnancy, IV. 55

Ascites (*contd.*)—
  diaphoresis in, II. 628
  diet in, II. 626
  diuretics in, II. 627
  general treatment of, II. 626
  operative measures in, II. 631
  pain in, II. 627
  paracentesis in, II. 628
  purgatives in, II. 627
  removal of, II. 627
  special forms of, II. 630
  tapping abdomen in, II. 629
Ascitic fluid in tuberculous peritonitis, removal of, II. 647
Asepsis in operative treatment of fractures, I. 636
Aspergillosis, pulmonary, I. 1116
Asphyxia in cut throat, II. 164
  local, II., 1238-1241
  of the newborn child, IV. 350-355, 473
    Schultze's artificial respiration in, IV. 352
    treatment of, IV. 351
Aspiration in hæmatoma, I. 545
  in joint affections, I. 755
  in pleural effusion, I. 1095
  of tuberculous abscess, I. 174
Aspirin in acute rheumatism, I. 271, 278
  in chronic rheumatism, I. 490
  in influenza, I. 233
Association method in hysteria, II. 1011
Asthma, I. 1035-1042
  application of vibration in, III. 216
  cardiac, I. 1253
  climate for, I. 1037
  diet in, I. 1036
  in children, I. 1041
  physical exercises in, III. 251
  pneumatic treatment of, I. 1042
  spasmodic, III. 691
  treatment in the intervals of the paroxysms, I. 1041
    of the ætiological factors of, I. 1035
    of the paroxysms of, 1038-1041
Astigmatism, III. 530
  irregular, III. 533
Astragalus, dislocation of, I. 733
  excision of, I. 775
  fracture of, I. 633
Ataxia of the vocal cords, III. 841
  in hemiplegia, II. 1188
Ataxy, locomotor, II. 1085-1092
  physical exercises in, III. 256
Atelectasis and collapse of the lung, I. 1063-1065
  in newborn child, IV. 361
Atmospheric influences, I. 534, 1118
  children susceptible to, I. 63
Atomiser for spraying nasal cavities, III. 696
Atoxyl in cancer, I. 149
  in pellagra, I. 522
  in syphilis, I. 321
  in trypanosomiasis, III. 420
  in undefined tropical fevers, III. 411

- **Atresia**, congenital, of the pylorus, II. 344
  - superficial, of the vulva, IV. 513
- **Atrophy**, muscular, in hemiplegia, II. 1187
  - myotonic, II. 1252
  - of the nails, III. 1082
  - progressive muscular, II. 1081-1082
- **Atropine**, hypodermic injection of, before operation, I. 84
  - in acute iritis, III. 584
  - in alcoholism, I. 501
  - in asthma, I. 1038
  - in constipation in adults, II. 446
  - in diabetes insipidus, I. 429
  - in diphtheritic paralysis, I. 200-201
  - in diseases of the heart, I. 1226
  - in hypermetropia, III. 536
  - in hyperopia, III. 536
  - in nocturnal enuresis, II. 75
  - in pneumonia, I. 262
  - poisoning by, I. 532
- **Atticotomy** in acute inflammation of the middle ear, III. 917
- **Attic** punch forceps, III. 916
- **Atwater** and Bryant, food analyses of, II. 192
- **Aural** probe, III. 908
  - snare, III. 909
  - vertigo, operation on, indication for, III. 974
- **Auricle**, abscess in lobule of, III. 882
  - angeioma of, III. 879
  - blackheads of, III. 881
  - cervical, III. 876
  - comedones of, III. 881
  - cysts of, III. 879
  - dermatitis of, phlegmonous, III. 881
  - dermoid cysts of, III. 879
  - diseases of, III. 880
    - local, III. 880-882
  - eczema of, III. 880
  - erysipelas of, III. 880
  - fibromata of, III. 879
  - foreign bodies in, III. 888
  - herpes of, III. 880
  - keloids of, III. 879
  - lupus of, III. 881
  - new growths of, III. 878
  - noma of, III. 882
  - perichondritis of, III. 881
  - Raynaud's disease of, III. 880
  - rodent ulcer of, III. 879
  - tophi of, III. 880
- **Auricles**, accessory, III. 876
- **Auricular** fibrillation of the heart, I. 1231
- **Auscultation** in normal labour, IV. 130
- **Auto-inoculation**, guides to the control of, I. 1162
  - in vaccine therapy, III. 264
  - regulation of in pulmonary tuberculosis, I. 1121
- **Auto-intoxication**, I. 386-390
  - in epilepsy, II. 993
- **Auto-massage** in constipation in adults, II. 463
- **Automatism** in epilepsy, II. 1005
- **Auvard's** three-bladed cephalotribe in craniotomy, IV. 410
- **Axilla**, in small-pox, immunity of, I. 303
- **Axillary** artery, excision of, in aneurysm, I. 1304
  - cellulitis, I. 183
- **Asoöspermia**, sterility in, IV. 848

- **Babes** and Vasilin on atoxyl in pellagra, I. 522
- **Bachman** on strophanthus, I. 1223
- **Bacillary** plugs, embolism by, I. 1306
- **Bacilluria**, II. 751
  - complicating typhoid fever, I. 361
  - in typhoid fever, I. 346
- **Bacillus** ærogenes capsulatus, gangrene due to, I. 582
  - coli infections, acute and chronic, III. 272
    - anti-coli serum in, III. 271
    - serum therapy in, III. 271-272
    - vaccine therapy in, III. 271-272
- **Bacon** fat in dietary of children, I. 59
- **Back (Ivor)**, circumcision, II. 880-881
  - diseases of bone, I. 695-712
  - diseases of the scrotum, II. 900
  - diseases of the testicle, II. 901-910
  - extravasation of urine, II. 893-894
  - fistulæ of the urethra, II. 894
  - injuries of the urethra, II. 882-885
  - peri-urethral abscess, II. 895-896
  - stricture of the urethra, II. 886-892
- **Back**, contusions of, I. 898
  - hot-air apparatus for, III. 323
  - suction apparatus for, in hyperæmic treatment, III. 60
  - wound of, I. 901
- **Bacterial** decomposition and gout, I. 450
  - food poisoning, I. 507-510
- **Bactericidal** serum therapy, III. 259
- **Bacterio-therapeutics** of diphtheria, III. 273-279
- **Bacteriology** of puerperal infection, IV. 284
- **Bacteriolysins** in serum therapy, III 259
- **Baden-Baden** spa, III. 147
- **Baden-Weiler** spa, III. 147
- **Bagneres de Bigorre** spa, III. 148
- **Bagnoles de l'Orne** spa, III. 148
- **Bagnoli** spa, III. 154
- **Bagshawe (A. G.)** trypanosomiasis, III. 417-422
- **Bailey, (H. C.)**, on strophanthus, I. 1222
- **Bainbridge (S.)**, on trypsin in cancer, I. 151
- **Bains-les-Bains** spa, III. 148
- **Balance** movements for scoliosis, III. 244
- **Balanitis**, II. 874
- **Ball (Sir Charles)**, method of operation for pruritus ani, II. 597
- **Ballance's** operation in diseases of the mastoid process, III. 928, 929

Ballantyne (J. W.), management of puberty and the menopause, IV. 498-503.
the general management of pregnancy, IV. 1-13
Balneotherapy in arthritis deformans, I. 397, 439
See also Baths *and* Mineral Waters.
Balsams, urinary, I. 226
Bandages, after abdominal operations, II. 267
for control of hæmorrhage, I. 798, 1259
for fractures of lower jaw, I. 87; II. 101
Bandaging in treatment of ulcers, I. 371
value of in shock, I. 97
Banting's treatment of obesity, I. 468, 471
Barbados tar in water itch, III. 486
Bardswell, on diet in tuberculosis, II. 203
Barèges spa, III. 149
Barium, salts of, poisoning by, I. 529
Barker's flushing spoon, use of, I. 175
Barker's solution, injection of, for spinal analgesia, III. 37
Barley water in infant feeding, IV. 347
preparation of, I. 42
Barr's antipyretic treatment in typhoid fever, I. 350
Barwell (Harold), diseases of the crico-arytenoid joint, III. 823
injuries of the larynx, III. 825-826
injuries and malformations of the nose, III. 671-677
leprosy of the nose, pharynx, and larynx, III. 780
lupus of the larynx, III. 838-839
of the pharynx, III. 781
and tuberculosis of the nares, III. 687-688
of the naso-pharynx, III. 742
new growths of the larynx (benign), III. 846-852
paroxysmal or vasomotor rhinorrhœa, III. 689-691
perichondritis of the larynx, III. 861-862
stenosis (cicatricial) of the larynx, III. 863-867
tuberculosis of the larynx, III. 870-875
of the pharynx, III. 793-794
Barwell-Lake epiglottis punch, III. 875
Basedow's disease, climate for, III. 99
Bashford (E. F.), on cancer in mice, I. 132
Basilar meningitis, chronic, I. 253-255
Bath, cabinet light, III. 187
combined double-light, III. 320
douche, III. 127
electric, III. 104
large, for recumbent position in radiant heat therapy, III. 318
for sitting position in radiant heat therapy, III. 317
light, III. 187
local light, III. 195
portable limb, for radiant heat therapy, III. 316
Bath (*contd.*)—
portable trunk in radiant heat therapy, III. 319
radiant heat, duration of, III. 325
reflector, in radiant heat therapy, III. 321
spa, III. 148
Baths, acid, III. 137
cold, in eclampsia, IV. 37
in impotence, I. 231
reaction to, III. 113
use of, I. 36
continuous, I. 38
creosote, in bronchiectasis, I. 1044
vapour, in pulmonary tuberculosis, I. 1149
effervescent, III. 131
electrical, in chronic synovitis and arthritis, I. 747
for chlorosis, II. 26
for infants and children, I. 47
for osteo-arthritis, I. 402
general action of, III. 112
hot air, I. 37, III. 128
in atony of the stomach, II. 289
in gouty joints, I. 397, 439
in obesity, I. 470
kinds of, and their uses, III. 124
local hot air, III. 128
local light, III. 194
marine, III. 129, 130
mineral, in diseases of the heart, I. 1210
mud, III. 136
peat, III. 135
sand, III. 136
special in chorea, II. 1263
sub-thermal, III. 113
sulphur, III. 133
superheated air, in gout and gouty conditions, I. 439
temperature of, I. 36, 38, 47
thermal, III. 124
in arthritis deformans, I. 397
Turkish, in acute gout, contra-indicated, I. 441
value of in children's diseases, I. 69
vapour, III. 129
warm, effect on nervous system, I. 70
Battaglia spa, III. 148
Battle's incision in appendicitis, II. 412
Bavarian splint, I. 574
Bayly (H. Wansey), the clinical pathology of syphilis in relation to treatment, I. 325-228
Bazin's disease, III. 1151
Beard, ringworm of, III. 1130
Beatson (Sir G.) on oöphorectomy in mammary cancer, I. 150
Beaunis' method of hypnotism, III. 164
Beckmann's post-nasal curette, III. 734
Bed, confinement to, after abdominal operations, II. 267
in acute bronchitis, I. 1050

- **Bed** (*contd.*)—
  - position of patient in, after abdominal operations, II. 266
  - preparation of for operation, I. 30
- **Bedclothes**, heavy, to be avoided, I. 45
- **Bedding**, disinfection of, I. 162
- **Bedmaking**, instructions as to, I. 30
- **Bedrooms**, disinfection of during and after contagious complaints, I. 164
- **Bedsores**, avoidance of, I. 157
  - in myelitis, II. 1218
  - in paraplegia, II. 1199
  - prevention of, I. 365
    - and treatment of, I. 31
    - in injuries of the spine, I. 910
- **Bed-wetting**, II. 75-77
- **Beds**, double and single, choice of, I. 26
- **Beef**, chemical composition of, II. 192
  - essence, preparation of, I. 43
  - inspection of, in the tropics, III. 385
  - raw, essence, preparation of, I. 42
- **Beef-tea** custard, preparation of, I. 43
  - peptonised, preparation of, I. 42
  - salted, as a stimulant, I. 158
- **Beer** in gouty conditions, I. 456
- **Bell (W. Blair)**, fistulæ of the uterus, IV. 664-668
  - hermaphroditism and pseudo-hermaphroditism, IV. 865-867
  - injuries of the uterus, IV. 707-710
  - malformations of the uterus, IV. 711-717
  - sub-involution of the uterus, IV. 720-724
- **Belladonna**, applications in spinal sprain, I. 900
  - dosage of in children's diseases, I. 68
  - in constipation in adults, II. 446
  - in epilepsy, II. 998
  - in exophthalmic goitre, II. 55
  - in nocturnal enuresis, II. 75
  - in small-pox, I. 305
  - in vomiting due to heart failure, I. 200
  - in whooping cough, I. 381
  - poisoning by, I. 532
- **Bell's** nerve, injuries of, II. 1112
  - treatment of spina bifida, I. 912
- **Bellingham** on aortic aneurysm, I. 1297
- **Belt** for gastroptosis, II. 320
  - for movable kidney, II. 788
  - use of, after abdominal operations, II. 268
- **Bennett (Norman C.)**, dental surgery, III. 1164-1194
- **Bennett (Sir William H.)**, varicocele, I. 1323-1327
  - varicose veins, I. 1309-1322
- **Benzene** compounds, poisoning by treatment of, I. 533
- **Béraneck's** tuberculin, III. 293
- **Berger's** amputation, I. 146
  - operation, re-section of clavicle, followed by division of main vessels and nerves, I. 831-834
- **Bergmann's** post-aural operation in diseases of mastoid process, III. 922-923
- **Beri-beri**, III. 414-416
  - neuritis in, II. 1139
- **Berkeley (Comyns)**, craniotomy, IV. 403-412
  - decapitation, IV. 413-415
  - evisceration, IV. 416
  - fibroids, IV. 634-663
  - forceps, IV. 417-432
  - induction of abortion and premature labour, IV. 433-445
  - infusion set for hæmorrhage, I. 1264
  - obstetric operations, IV. 373-374
  - on connection between leucoplakia and cancer, I. 119.
  - spondylotomy, IV. 451
  - version or turning, IV. 461-473
- **Berkeley's** infusion apparatus, IV. 478
  - self-containing retractor, IV. 477
  - table, IV. 480
  - vaginal clamp, IV. 481
- **Bernheim's** method of hypnotism, III. 164
- **Berries**, chemical composition of, II. 196
- **Berry (James)**, affections of the lips, II. 96-98
  - cleft palate, II. 147-156
  - harelip, II. 85-95
- **Besridka**, on serum therapy of scarlet fever, I. 287
- **Beta-naphthol** in ankylostomiasis, III. 492
- **Bex** spa, III. 148
- **Beyea's** operation for gastroptosis, II. 324
- **Bezold's** mastoid abscess, III. 932
- **Bicarbonate** of Soda. *See* Soda.
- **Bier's** hyperæmic treatment by means of cupping glasses, III. 56
  - by partial vacuum, III. 56
  - by suction apparatus, III. 56
  - "heated air," III. 61
  - in acute abscess, I. 168-182
  - in whitlow, I. 169
  - induced hyperæmia, III. 40-68
  - in infective lesions of scalp, I. 888
  - in tuberculous joints, I. 751
  - methods and rules of, III. 43, 45
  - passive, induced by elastic constriction, III. 46
- **Big** heel, III. 465
- **Bigelow's** method in dislocations, I. 724
- **Bile** on constipation in adults, II. 454
  - stagnation of, and cholelithiasis, II. 682
- **Bile** ducts, cancer of, obstruction due to, I. 143
  - catarrh of, infective, II. 704
  - congenital obliteration of, II. 673
  - croupous inflammation of, II. 702
  - diseases of, II. 680
  - fistulæ of, II. 699
  - inflammation of, II. 699-709
  - injuries of, II. 680
  - perforation of, II. 707
  - primary malignant disease of, II. 713
  - stricture of, II. 706
  - tumours of, II. 713-715
    - cystic, II. 713

Bile (*contd.*)—
  typhoid infection of, I. 353
    passages, injection of, and cholelithiasis, II. 683
    wounds of, II. 680
Bilharzia disease, III. 498-500
  general treatment in, III. 499
  medicinal treatment of, III. 499
  preceding carcinoma, I. 119
  prophylaxis of, III. 498
Biliousness, effect of chalky water in, II. 345
Binder in third stage of labour, IV. 125
Biniodide solution for actinomycosis, I. 177
Birth, injuries of newborn child, IV. 363
  marks, III. 1077-1081
  paralysis, brachial, II. 1110
Bismuth, carbonate of, in acute gastritis, II. 352
  dressing, ineffective, I. 78
  emulsion of, injection into abscess cavities, I. 176
  in achylia, II. 294
  in chronic dilatation of the stomach, II. 314
  in typhoid fever, I. 354
  injection of, in fistulous tracks in empyema, I. 1110
  mixture in vomiting, I. 507, 509
Blacker (G.), menorrhagia and metrorrhagia, IV. 751-764
Blackheads of the auricle, III. 881
Blackwater fever, III. 386-389
  local applications in, III. 389
  stimulants in, III. 389
  use of morphia in, III. 388
Bladder, acquired sacculation of, in vesical calculus, II. 854, 864
  calculus of, II. 852-857
  cancer of, II. 871
    fistula due to, I. 142
    palliative operations for, II. 873
  care of, after abdominal operations, II. 264
  complications, in gynæcological surgery, IV. 487, 496
  control of, in children, I. 53
    in typhoid fever, I. 362
  diseases of, II. 852
  diverticula of, II. 864
  ectopia, II. 866
  extrophy of, in newborn child, IV. 360
  female, calculi in, IV. 733
    in supra-pubic cystotomy, IV. 734
    diseases of, IV. 868, 875
    displacements of, IV. 875
    fissure of neck of, IV. 883
    foreign bodies in, IV. 875
  fistulæ of, at the umbilicus in adults, II. 279
    in infants, II. 278
  gun-shot wounds of, I. 566
  hydronephrosis due to obstruction in, II. 772

Bladder (*contd.*)—
  in abdominal operations, II. 259
  in gynæcological surgery, IV. 487, 496
  inflammation of, complicating typhoid fever, I. 361
  injuries to, II. 252
  intestine and, fistulæ between, II. 491
  papilloma of, single, II. 870
  papillomata of, multiple, II. 871
  plastic closure of, in ectopia vesicæ, II. 866
  rupture of, II. 868
    after treatment, II. 869
  sacculi of, II. 854, 864
  separation of, in Wertheim's operation, IV. 606
  sphincter of, troublesome in tabes dorsalis, II. 1090
    weakness in disseminated sclerosis, II. 1075
  tuberculosis of, II. 820, 824
  tumours of, I. 119, 120 ; II. 870-873
  washing out of, I. 910
  wounds of, II. 868-869
Blake's tympanic syringe, III. 912
Bland-Sutton (J.), actinomycosis of Fallopian tube, IV. 800
  cancer of Fallopian tube, IV. 801-803
  chorion-epithelioma of Fallopian tube, IV. 804
  diseases and affections of the Fallopian tubes, IV. 799-823
  hernia of the Fallopian tube, IV. 804
  hydatids of the broad ligaments, IV. 820-821
  inflammation of the Fallopian tube (salpingitis), IV. 805-815
  papilloma of the Fallopian tube, IV. 816
  preventive treatment of salpingitis, IV. 815
  thrombosis of the veins of the broad ligaments, IV. 822-823
  tubal pregnancy, IV. 78-88
  tuberculous diseases of the Fallopian tubes (tuberculous salpingitis), IV. 817-819
  tumours of the broad ligaments, IV. 823
Blankets, disinfection of, I. 162
Blastomycetic dermatitis, III. 1005
Blepharitis of the eyelids, iii. 577
Blepharospasm, clonic, II. 1047
Blindness, snow, of the conjunctiva, III. 560
Blistering in chorea, II. 1262
Blisters, application of, I. 36
  in counter-irritation in rheumatoid arthritis, I. 405
  in iritis, III. 586
  in joint affections, I. 748
  value of in children's diseases, I. 69
Blondel (Raoul) on lacto serum, I. 1295
Blood, action of arc light bath on, III. 191
  anæmia due to actual loss of, II. 18-19
  circulation of, effect of massage on, III. 204

Blood circulation (*contd.*)—
    effect of shock on, I. 94
    in Bier's hyperæmic treatment, III. 42
  coagulability of, effect of animal serum on, I. 129
  coagulation of, encouragement of, in hæmophilia, II. 32
  count, differential, in pelvic cellulitis, IV. 826
  deficiency of lime salts in, IV. 721
  direct transfusion of, in hæmorrhage, I. 1269
  diseases of, II. 1-45
  effusion of in fractures, I. 570
  elimination of noxious materials from, I. 7
  in normal puerperium, IV. 258
  massage in, III. 207
  transfusion of in pellagra, I. 523
  See also Transfusion.
Blood cysts of neck, II. 167
Blood-forming organs, diseases of, II. 1-45
Blood mole complicating pregnancy, IV. 59
Blood-pressure, I. 1281-1286
  effect of infusion in, I. 98, 102
  high, I. 1281
    relief for, I. 10
  in cerebral compression, I. 880
  in gouty subjects, I. 436
  influence of shock on, I. 93
  low, I. 1284
Blood stasis, torsion-clamp method of in elephantiasis scroti, III. 509
Blood states, abnormal, cerebral thrombosis due to, II. 1179
Blood-vessels, division of in Berger's operation, I. 831
  injuries to large, I. 1030
  ligature of, I. 1254
    in amputations, I. 801
  special, wounds of, I. 1274
Blue light, use of, III. 187
  bath, III. 193
  pill in gout, I. 432, 436
    in gouty complications, I. 443-446
Blumfield (**J**.), anæsthetics, III. 1-39
Body, causes of loss of natural resistance to disease in, I. 5
Boeck, multiple benign sarcoid of, III. 1152
Boiling, disinfection by means of, I. 161
  sterilisation by, I. 72
  of instruments, directions for, I. 27, 30
Boils, ceridine in, III. 1008
  complicating diabetes mellitus, I. 425
  general treatment of, III. 1007
  ionic medication of, III. 184
  local treatment of, III. 1009
  nuclein in, III. 1008
  r in, III. 1007
  reatment of, III. 1008
  II. 1006
v. Bokay on intubation, III. 804
Bone-grafting in sarcoma of jaws, II. 115
Bone-marrow in pernicious anæmia, II. 9
Bones, cancer of, spontaneous fractures in, I. 146
  deformities of in children, I. 56
    in rickets, I. 481
  direct union of, in fracture of the jaws, II. 102
  diseases of, I. 695-712, 756, 772
  complicating typhoid fever, I. 363
  fracture of, in extraction of teeth, III. 1188
  infective lesions of, I. 889
  injuries of, I. 568-633
  necrosis of following abscess, I. 167, 171
    in burns, I. 541
    vaccine therapy in, III. 264
  sarcoma of, Coley's fluid in, I. 153
    section of, I. 800
    spread of, I. 124, 711
  tuberculosis of, I. 704
  tumours of, I. 708
Bonney (Victor), after-treatment and post-operative complications of gynæcological surgery, IV. 487-497
  carcinoma of body of uterus, IV. 575-581
    the cervix, IV. 582-617
  chorio-carcinoma (chorion epithelioma, deciduous malignum), IV. 618-619
  connection between cancer and leucoplakia, I. 117
  general points in the technique of gynæcological operations, IV. 474-486
  puerperal infection, IV. 282-323
  sarcoma of the uterus, IV. 718-719
Bonney's dissecting forceps, IV. 476, 477
  needles, IV. 477
  vaginal clamp, IV. 481
Boracic dressings in burns and scalds, I. 541
  fomentations in cellulitis, I. 181
Borax in thrush, II. 123
Boric gauze and wool, I. 78
Bormio spa, III. 148
Bossi's dilator in accidental hæmorrhage during pregnancy, IV. 26
  metallic dilator in eclampsia, IV. 39
Bottle-feeding of infants, II. 221
Botulism, I. 510
Bouchard, on auto-intoxication, I. 386
Bougie, black elastic œsophageal, II. 172
  conical-ended black elastic œsophageal, II. 172
  Eustachian, in patency of Eustachian tube. III. 949
  gum-elastic, in inducing of premature labour, IV. 437
  Schrötter's hollow vulcanite, III. 865
  silk web œsophageal, II. 172, 173
  sterilisation of, I. 92

- **Bourbon-l'Achambauld** spa, III. 148
- **Bourbon-Lancy** spa, III. 148
- **Bourbonne-les-Bains** spa, III. 148
- **la Bourboule** spa, III. 152
- **Bowels.** *See* Intestines.
- **Bow-leg** and genu varum, I. 962
- **Bowls** and dishes, preparation of, I. 72
- **Bowman's** spoon for cataract, III. 628
- **Boxwood** screw wedges in fibrous ankylosis of the jaws, II. 106
  - wedge for fibrous ankylosis of the jaw, II. 106
- **Brachial** artery, hæmorrhage from, I. 1275
  - birth paralysis, II. 1012, 1110; IV. 365
  - neuralgia, II. 1121
  - plexus, injuries of, II. 1012, 1110
- **Braid's** method of hypnotism, III. 160, 163
- **Brain**, abscess of, complicating diseases of the ear, III. 939-941
    - following head injuries, I. 885
  - anæmia of, due to shock, I. 94
  - apoplexy of, II. 1070
  - compression of, I. 878, 880
  - concussion of, I. 878
  - contusion of, I. 878
  - direct drainage from, in meningitis, I. 252
  - diseases of, II. 1143
    - aphasia in, II. 1143-1149
    - electro-therapeutics in, III. 109
    - paraplegia in, II. 1195
    - speech defects in, II. 1143
  - embolism of, II. 1167
  - exhaustion of the vasomotor centres in, I. 96
  - gouty conditions of, I. 447
  - gunshot injuries of, I. 562
  - hæmorrhage of, II. 1168-1176
  - hernia of, II. 1190
  - injuries of, I. 878-884
  - œdema of, in injuries of the head, I. 884
  - palsies of, in infancy, II. 1055-1058, 1153-1156
    - surgical treatment, II. 1059-1066, 1157-1164
  - syphilis of, headache from, II. 1034
  - thrombosis of, II. 1177-1180
    - syphilitic, II. 1068
  - tumours of,
    - fits in, II. 1202
    - in children, II. 1068, 1166
    - intra-cranial, localised, II. 1202. 1203
    - medical treatment, II. 1200-1203
    - optic neuritis in, II. 1201
    - palliative operations in, II. 1204
    - radical operations in, II. 1205
    - surgical treatment of, II. 1204-1207
- **Bramwell's** method of hypnotism, III. 165
- **Branchial** cysts of neck, II. 167
  - dermoids, I. 110
  - fistulæ of neck, II. 166
- **Brand** cancers of cattle, I. 117
- **Brandy** in collapse and diarrhœa, I. 28, 37, 508
- **Brawny** arm of cancer of breast, treatment of, I. 144
- **Bread**, chemical composition of, II. 195
  - cleansing of walls by, I. 163
  - food in diabetes, I. 413
  - in diet for gout, I. 454
  - in dietary of children, I. 59
  - rye, gangrene from use of, I. 219
- **Breakfast**, abuse of, in dietary of children, I. 62
- **Breast**, abscess of, II. 958
  - affections of, in pregnancy, IV. 330-336
    - in the puerperium, IV. 330-336
  - atrophic scirrhus of, II. 964
  - cancer of, after-treatment in radical operations for, II. 972
    - age of patient and, II. 965
    - anæsthetics in operations for, III. 31
    - axillary dissection in radical operation for, II. 970
    - both, II. 965
    - chronic alcoholism and, II. 966
    - chronic bronchitis and, II. 966
    - cirrhosis and, II. 966
    - complications of, I. 145, 146
    - diabetes and, II. 966
    - drainage after radical operation for, II. 971
    - dressings after radical operations for, II. 972
    - exploration of tumour in, II. 968
    - incision in radical operation for, II. 969
    - oöphorectomy in, I. 150
    - operations for, II. 967
    - palliative operations for, II. 973
    - position of patient in radical operation for, II. 968
    - pregnancy and, II. 965
    - preparation of patient for radical operation for, II. 967
    - radical operation for, II. 967
    - radium therapy in, III. 313
    - recurrent, II. 974
    - spread of, I. 126
    - suture of wound after radical operation for, II. 971
  - care of, in normal puerperium, IV. 266
  - chronic abscess of, II. 962
  - cysts of, II. 952-954
    - multiple, II., 952
    - operation for, II. 953
    - simple, II. 952
    - with intra-cystic growths, II. 954
  - diseases and affections of, II. 952-981
  - duct papilloma of, II. 954
  - fever in puerperal sepsis, IV. 315
  - fibro-adenomata of, II. 955
    - operation for, II. 955
  - galactocele of, II. 953
  - hydatid cysts of, II. 954
  - hypertrophy of II. 957

- **Breast** (*contd.*)—
  - in normal puerperium, IV. 258
  - inflammation of, II. 958-962
  - infra-mammary abscess of, II. 960
  - malignant disease of, II. 963-975
    - enlargement of supra - clavicular glands in, II. 964
    - indications for operation, II. 963
    - results of operative treatment, II. 963
  - management of, in pregnancy, IV. 330
  - massage of, for painful engorgement, IV. 332
  - mastitis of, chronic interstitial, II. 961
    - chronic lobar, II. 961
  - neuralgia of, II. 976
  - operations upon, preparations for, I. 89
  - painful engorgement of, in the puerperium, IV. 331
  - persistent sinuses of, II. 960
  - removal of, in malignant disease of, II. 971
  - sarcoma of, II. 975
  - suction apparatus for, in hyperæmic treatment, III. 60
  - supra-mammary abscess of, II. 960
  - treatment of. when patient is not going to suckle the infant, IV. 330
  - tuberculosis of, II. 981
  - tumours of, operative diagnosis of, II. 979-980
    - doubtful, II. 979
- **Breast-feeding**, contra-indications to, in normal puerperium, IV. 269
  - in normal puerperium, IV. 266
  - of infants, II. 215
  - of the new-born child, IV. 340
- **Breath**, chronic fœtor of, II. 127
- **Breathing**, children to be instructed as to, I. 49
  - exercises, III. 227
    - in pulmonary diseases, III. 249
- **Brehmer** on pulmonary tuberculosis, I. 1121
- **Brewis, (N. T.)**. endometritis, IV. 620-631
  - erosion or adenomatous disease of the cervix, IV. 632-633
  - hypertrophy of the cervix, IV. 700-706
- **Brides les-Bains** spa, III. 149
- **Brides-Salins** spas, III. 149
- **Bridge of Allan** spa, III. 149
- **Bright's** disease, acute, II. 796-797
  - acerbations in, II. 798
  - chronic, II. 798
    - decapsulation in, II. 799
  - epistaxis in, I. 15
  - in anæmia, II. 17
- **Brine** baths, III. 130
- **Briscoe** (**J. C.**), Broncho-pneumonia, I. 1066-1073
- **Broad** ligaments, diseases of, IV. 836-839
  - fibroids of, IV. 653
    - false, IV. 652
  - hydatids of, IV. 836-837
  - tumours of, IV. 839
  - veins of, thrombosis of, IV. 838-839
- **Bromide** acne, II. 997
- **Bromides**, combinations of, in epilepsy, II. 996
  - dosage of, in children's diseases, I. 67
    - in epilepsy, II. 995
  - in diseases of the heart, I. 1225
  - in epilepsy, II. 993
  - in small-pox, I. 305
- **Bromine**, new preparations of, II. 997
- **Bromism** in epilepsy, II. 994
- **Bromoform** in whooping cough, I. 382
- **Bronchi**, diseases of, I. 1035-1075
  - empyema ruptured into, I. 1106
  - foreign bodies in, abscess due to, I. 1061
- **Bronchial** catarrh, complicating influenza, I. 239
- **Bronchiectasis**, I. 1043-1048
  - methods of treatment of, I. 1047
  - surgical treatment of, I. 1048
- **Bronchiectatic** cavities of the lung, I. 1061
- **Bronchitis** I. 1049-1058
  - acute, general measures, I. 1050
  - chronic, I. 1054-1058
    - climatic treatment of, I. 1055
    - complicating cancer of the breast, II. 966
    - general measures in, I. 1054
    - medicinal treatment of, I. 1056
    - physical exercises in, III. 251
    - vaccine treatment of, I. 1056
  - complicating gynæcological surgery, IV. 494
    - whooping cough, I. 378, 384
  - in injuries of the spine, I. 909
  - in measles, I. 245
  - in myelitis, II. 1216
  - medicinal measures in, I. 1051
  - peculiar forms of, I. 1058
  - plastic, I. 1058
  - putrid, I. 1058
  - sicca, I. 1058
  - sub-acute, I. 1053
- **Broncho-pneumonia**, I. 1066-1073
  - complicating gynæcological surgery, IV. 494
    - small-pox, I. 308
  - diet in, I. 1068
  - drugs in, I. 1068
  - general management in, I. 1066
  - special symptoms in early stages of, I. 1069
  - treatment in the later stages of, I. 1070
- **Bronchorrhœa serosa**, I. 1058
- **Bronchoscope**, Brünings, III. 810
  - introduction of, in foreign bodies in the air passages, III. 816
- **Bronchoscopy**, description of, III. 803-821
- **Brophy's** operation in cleft palate, II. 149
- **Broths** for young children, I. 58
- **Brow** presentation, forceps in, IV. 422
  - in labour, IV. 137-139

Brown (W. Carnegie), ankylostomasis (uncinariasis, hookworm disease), III. 487-492
  ascariasis, oxyuriasis and trichocephalis, III. 493-497
  dracontiasis (infection by guinea-worm, filaria medinensis), III. 501-502
  leprosy, III. 447-453
  oriental sore, III. 454-456
  sprue, III. 442-446
  tæniasis, intestinal, III. 517-520
  trichiniasis (trichinosis, trichinelliasis), III. 524-527
  ulcerating granuloma of the pudenda, III. 457-458
  yaws (framboesia tropica), III. 461
Bruce (J. Mitchell), principles of treatment, I. 1-25
Bruce (W. Ironside), X-ray treatment of diseases other than skin diseases, III. 360-368
Brünings bronchoscope, III. 806
  dilatable bronchoscope, description of, III. 810
  direct laryngoscope, III. 849
  forceps, description of, III. 808
  hand lamp, description of, III. 810
  œsophagoscope for foreign bodies in the œsophagus, II. 187
Brunton (Sir T. L.), on arterio-sclerosis, I. 1294
Bryant's splint, I. 617
  suspension apparatus for fractures of femur, I. 616
Bubo, climatic, III. 467
  parotid, II. 131
  plague, III. 405
  suppurating, complicating chancre, I. 315
Buckley (Charles W.), rheumatism (chronic), I. 483-491
  (muscular), I. 492-494
Budd on incidence of gout, I. 448
Bulbar palsy, II. 1061
  acute, II., 1061
  progressive. II. 1061
Buller's shield for gonorrhœal ophthalmia in the adult, III. 555
Bullet wounds. *See* Wounds, gunshot.
Burns, continuous baths for, I. 38
  scars of, the seat of carcinoma, I. 117
  and injuries by electricity, I. 547-549
  and scalds, I. 540-544
    general treatment of, I. 543
    immediate treatment of, I. 540
    local treatment of the burnt areas in, I. 540
  and treatment of contractions, I. 543
  of the conjunctiva. III. 547
  of the external ear, III. 888
  of the œsophagus, II. 188
Burrows' solution in erysipelas, I. 210
Bursæ and cysts in association with arthritis, I. 749-750
  chronic rheumatism of, I. 484
Bursæ (*contd.*)—
  diseases of, II. 1334-1335
  prepatellar, chronic bursitis of, II. 1334
  wounds of, II. 1335
Bursal cyst of neck, II. 168
Bursitis, acute, II. 1334
  chronic simple, II. 1334
  syphilitic, II. 1335
  tuberculous, II. 1335
Bury (Judson S.), acute anterior poliomyelitis, II. 1055-1058
  facial paralysis, II. 1093-1095
Butlin (Sir H. T.) on mortality from operations on jaws, II. 117
  on operations on the tongue, II. 140, 143
Butyl chloral in infantile diseases, I. 67
Buxton spa, III. 149
Buzzard (E. Farquhar), caisson disease, II. 1208-1209
  cerebro-spinal syphilis, II. 1063-1069
  general paralysis of the insane, II. 1077-1080
  hæmatomyelia, II. 1210-1211
  hemiplegia, II. 1181-1190
  myelitis, II. 1212-1218

Cachexia, relief of in inoperable cancer, I. 132
  saturnine, in lead poisoning, I. 514
  strumipriva complicating operation for goitre, II. 70
Cæcal region, growths in, excision of, II. 580
Cæcostomy for cancer of the colon, II. 584
  in chronic mucous colitis, II. 571
  valvular, in chronic mucous colitis, II. 571, 573
Cæcum, cancer of, relief of obstruction in, I. 141
Cæsarean hysterectomy, IV. 398-402
    mortality from, IV. 401
    operation of, IV. 399
  operation for contracted pelvis, table of mortality of, IV. 402
  section, IV. 382-398
    abdominal, in eclampsia, IV. 40
      incision in, IV. 387
    after-treatment of, IV. 396
    ethical standpoint of, IV. 394
    extraction of child in, IV. 390
    extra-peritoneal, IV. 397
    in accidental hæmorrhage during pregnancy, IV. 25
    in contracted pelvis, IV. 383
      complicating labour, IV. 170, 171
    in eclampsia, IV. 384
    in fibro-myomata of the uterus, IV. 384
    in ovarian tumours, IV. 384
    in placenta prævia, IV. 385
    mortality from, IV. 401

- **Cæsarean** section (*contd.*)—
  - preparation of patient in, IV. 385
  - removal of placenta in, IV. 391
  - repeated, danger of, IV. 395
  - sterilisation in, IV. 394, 396
  - stitching the uterus in, IV. 391
  - time of operating in, IV. 386
  - uterine incision in, IV. 388
  - vaginal, for inducing abortion, IV. 437
    - in forcible methods of delivery, IV. 444
- **Caffeine** citrate for relief of pain, I. 134
  - in diseases of the heart, I. 1227
  - in influenza, I. 233
- **Caiger (F. Foord)** and **H. E. Cuff**, diphtheria, I. 187-202
  - general treatment of infectious diseases, I. 157-160
  - scarlet fever, I. 281-294
  - typhus fever, I. 365-367
- **Caisson** disease, I. 1306 ; II. 1208-1209
  - preventive measures, II. 1208
  - remedial measures, II. 1208
- **Calabar** bean, poisoning by, I. 533
- **Calcareous** deposits of the tympanic membrane, III. 892
  - waters, III. 120
- **Calcium** chloride in hæmorrhage, I. 1261
  - lactate in acute alcoholism, I. 495
    - in hæmophilia, II. 34
    - in hæmorrhage, I. 1261
  - permanganate of in lead colic, I. 513
- **Calculous** disease, diet in, II. 207
- **Calculus**, II. 753-766
  - anuria in, II. 755
    - operations for, II. 757
  - bilateral renal, II. 765
  - in a solitary kidney, II. 766
  - nephrectomy for, II. 765, 779
  - pancreatic, II. 724-725
  - prophylactic treatment, II. 753
  - prostatic, II. 918
    - complicating prostatic adenoma, II. 945
  - renal, cases unsuitable for operation, II. 758
    - colic and, II. 755
    - hæmaturia and, II. 755
    - hydronephrosis with, II. 773
    - nephrolithotomy for, II. 759, 764
    - operative treatment of, II. 758
    - pyelolithotomy for, II. 763, 764
  - salivary impacted, causing simple parotitis, II. 157
    - and inflammation of parotid gland, II. 159
  - ureteral, II. 846-851
  - vesical, II. 852-857
    - in female bladder, IV. 876
    - litholapaxy in, II. 854, 855
    - median perineal lithotomy for, II. 856
    - mineral waters and baths in, III. 140
    - operations for, II. 854
- **Calculus** vesical (*contd.*)—
    - preventive treatment of, II. 853
    - removal of through urethra, IV. 876
    - supra-pubic lithotomy for, II. 856
- **Callard** diabetic food, I. 414, 418, 421
  - flour, I. 421
- **Callus**, formation of, massage and, I. 579
- **Calomel** in acute gastritis, II. 347
  - in acute gout, I. 432
  - in acute rheumatism, I. 270
  - in amœbic dysentery, III. 432
  - in syphilis, I. 318
  - in typhoid fever, I. 353
- **Caloric** value of foods, II. 198
  - table of values, II. 198
- **Calvities** or alopecia seborrhoica, III. 1001
- **Cameron (Samuel J.)**, amenorrhœa and scanty menstruation, IV. 725-735
- **Camphor**, compound tincture of, use of, I. 245
  - in chronic congestion of the lungs, I. 1079
  - liniment in bronchitis, I. 245
- **Cancer** *à deux*, I. 120
  - ætiology of, I. 116-119
  - alder leaves in, I. 149
  - and anæmia, II. 16
  - atoxyl in, I. 149
  - cataphoresis in, I. 153
  - chronic irritation as a cause, I. 118
  - Coley's fluid in, I. 152
  - diagnosis of, I. 121
  - drug treatment of, I. 148
  - electrical methods in, I. 153
  - exploratory incision in, I. 121
  - ferments in treatment of, I. 151
  - fulguration in, I. 154
  - gastric, II. 296-301
  - general principles of treatment of, I. 116-156
  - hæmorrhage from stomach in, II. 329
  - infection of, I. 120
  - inoperable, treatment of, by control of discharge, hæmorrhage and ulceration, I. 136
    - by empirical remedies, I. 147
    - by palliative removal of growth, I. 131
    - by relief of cachexia, I. 132
    - by relief of obstructions, I. 138
    - by relief of pain, I. 133
    - by relief of special symptoms, I. 144
    - by vaccines, I. 133
  - irradiation in, I. 155
  - Keith methods in, I. 149
  - local infection in same individual, I. 120
  - lymphatic permeation of, I. 125
  - mammary, spread of, I. 126
  - metastatic growths of, I. 124
  - of alimentary system, I. 139-142
  - of ampulla of Vater, II. 714
  - of biliary passages, I. 143

Cancer (*contd.*)—
  of bladder, II. 871
  of bones of the skull, I. 895
  of both breasts, II. 965
  of cervix uteri, IV. 567, 582 617
  of colon, II. 578-584
  of corpus uteri, leucorrhœa in, IV. 570
  of female urethra, IV. 872
  of Fallopian tube, IV. 801-803
  of glands, I. 1350
  of jaws, II. 112
    mortality of, II. 117
  of pancreas, II. 729
  of prostate, II. 933
  of respiratory organs, I. 142
  of tongue, operative treatment, II. 141-144
  of urinary organs, I. 142
  of uterus, IV. 570, 575-581
  oöphorectomy in, I. 150
  operability of, I. 122
  operations on, complications of, I. 128
  organo-therapy in, I. 149
  pain in, relief of, I. 133
  pathological anatomy of, I. 123
  placental extract in, I. 150
  post-operative treatment of, I. 129
  pre-cancerous conditions, I. 116-119
  preventive treatment of, I. 116-121
  primary, of the vagina, IV. 553
  radical treatment of operable, I. 123
  radium in, I. 155
  recurrence of, I. 123
  secondary of the umbilicus, II. 281
  serum treatment of, I. 152
  soamin in, I. 149
  squamous cell, eczema preceding, I. 117
    ovarian dermoids the seat of, I. 110
  synthetic preparations in, I. 149
  thymus extract in, I. 150
  thyroid extract in, I. 150
  vaccine therapy of, I. 152
  vegetable preparations for, I. 148
  violet leaves in, I. 149
  X-ray treatment in inoperable, I. 155
Cancer-cell injection of operation area in vaginal hysterectomy, IV. 600
ancer-cells, growth of, inhibition of, I. 129
ancer-houses, I. 120
ancroin, valueless, I. 152
ancrum oris, II. 124-125
  complicating measles, I. 247
    typhoid fever, I. 357
and noma, gangrenous, I. 219
nines, lower, extraction of, III. 1183
upper, extraction of, 1181
nnula for venous infusion, subcutaneous, IV. 222
tharides plasters in counter-irritation for rheumatoid arthritis, I. 405
oisoning by, treatment of, I. 532
tlie (James), abscess of the liver, rgical aspects of, II. 648-656
sule forceps for cataract, III. 626
Caraate or pinta, III. 477
Carbohydrates, digestion of, II. 191
  effect in rickets, I. 479, 481
  food-tables, showing percentages of, I. 411, 419
  foods arranged in order of value in, II. 197
  in diabetes mellitus, I. 422
  in dietetics, II. 201
  in typhoid fever, I. 342
Carbolic acid antiseptic in typhoid fever, I. 351, 354
  in pruritis, III. 1098
  in ulcer of the cornea, III. 565
  in whooping cough, I. 382
  poisoning by, I. 527
  sterilisation with, I. 72
  fomentations, gangrene following, I. 168, 170
  gauze and wool, I. 78
Carbon dioxide in port-wine stains, III. 1078
    poisoning, I. 534
    solid, in lupus erythematosus, III. 1071
      rodent ulcer treated by, I. 115
      in warts, III. 1157
    snow in small capillary nævi, III. 1078
  monoxide poisoning, I. 534
Carbonic acid poisoning, I. 534
Carbuncles, I. 888 ; III. 1012-1014
  complicating diabetes mellitus, I. 425
  general treatment of, III. 406, 1012
  in plague, III. 406
  ionic medication of, III. 184
  local treatment of, III. 1013
  vaccine treatment of, III. 1013
Carcinoma. *See* Cancer.
Carden's operation, I. 862
Cardio-vascular disease in insomnia, II. 1019
Cardiolysis in pericarditis, I. 1189
Cardiospasm of the stomach, II. 357
Carlsbad water in acute gastritis, II. 347, 352
Carneous mole complicating pregnancy, IV. 59
Carpets, disinfection of, I. 162
  in sick room, cleansing of, I. 26
  use of in nursery, I. 44
Capillary hæmorrhage, I. 1272
Carotid artery, common, excision of, in aneurysm, I. 1303
    wounds of, I. 1274
  external, excision of, in aneurysm, I. 1303
    wounds of, I. 1274
  internal, excision of, in aneurysm, I. 1303
    wounds of, I. 1274
Carpus, fractures of, I. 604
Carr (J. Walter), whooping cough, I. 376-385
"**Carriers**" of disease, I. 336

" **Carrion's** fever," III. 459
Carr's splint, I. 603
Carton's catheter, IV. 115
Caruncle of the female urethra, IV. 872
  vascular, of the meatus urinarius, IV. 512
Cascara sagrada in constipation in adults, II. 448
Caseation in tuberculous disease of the knee-joint, I. 768
Castellammare spa, III. 149
Castor oil enema, I. 32
  in constipation in adults, II. 448
Cataphoresis in arthritis and synovitis, I. 746
  in cancer, I. 153
  in gout and gouty conditions, I. 441
Cataract, III. 607-641
  after-, III. 634
    complicated capsular opacities, III. 637
    simple capsular opacities, III. 634
  complete milky, III. 608
  complicated, III. 641
  complications by presentation of vitreous humour, III. 628
  extracting, bandages for eyes after, III. 631
  immature, Smith's operation for, III. 621
  juvenile, III. 607
  lamellar, III. 608
    curette evacuation of lens in, III. 613
    discission of the lens in, III. 611
    linear extraction of lens in, III. 613
    operative treatment of lens in, III. 611
  mature, delivery of the lens in, III. 626
    general treatment, III. 633
    iridectomy for, III. 624
    operations for, III. 622
      anæsthetic in, III. 622
    position of patient and surgeon in, III. 623
    post-operative treatment of, III. 630
    preparation of patient in operation for, III. 622
    solutions for use in, III. 623
  preliminary iridectomy in, III. 619
  refraction and, III. 618
  secondary, III. 641
  senile, III. 615
    ante-operative treatment, III. 616
    artificial maturation of, III. 620
    immature, operations to extract, III. 620
    monocular, III. 615
  shrunken malformed lenses in, III 607
  toilet after, III. 627
  traumatic, III. 638
Catarrh, avoidance of in infants and children, I. 46, 52
  chronic endo-cervical in nulliparæ, IV. 566
  conjunctival, III. 551
  gastric, alkalies in, I. 64
Catarrh, gastric (*contd.*)—
    diet in, II. 209
    or acute indigestion, I. 506-507
  mineral waters and baths in, III. 143
  nasal, in young children, I. 49
  naso-pharyngeal, III. 739-741
  of upper air passages, climate for, III. 101
  pituitous, I. 1058
  spring, of the conjunctiva, III. 560
Catgut ligatures, sterilisation of, I. 72
  suture, continuous, in operation for inguinal hernia, II. 506
Cathcart (George C.), stammering, III. 327-330
  voice production, III. 331-340
Catheter, Carton's, IV. 115
  Eustachian, for patency of Eustachian tube, III. 948
  for nasal feeding, I. 33
  for rectal feeding, I. 29
  Jacques's, in cancer of the stomach, II. 306
  passing of, I. 40
    in females, I. 40
  sterilisation of, I. 92, 909
  ureteral, drainage by in pyonephrosis, II. 815
Caton, on cardiac lesions in rheumatism, I. 278
Cattle, cancer in, I. 117
Caustic alkalies, poisoning by, I. 527
  fluids, injuries to stomach by, II. 284
Caustics in cancer, I. 148
  of cervix, IV. 616
Cauterets spa, III. 149
Cauterisation in cancer of cervix, IV. 615
  in lupus, III. 1149
  of granulations in chronic inflammation of the middle ear, III. 908
Cautery, galvano, in hæmorrhage, I. 1258, 1260
  in hæmorrhoids, II. 619
Cautley (Edmund), hypertrophic stenosis of the pylorus, II. 337-341
  laryngeal spasm in children, III. 827-830
  night terrors, II. 1036-1037
  rickets, I. 478-482
  tetany in children, II. 1272-1273
Cavernositis, II. 874
Cellulitis, axillary, I. 183
  causes of, I. 181
  cervical, complicating scarlet fever, I. 290
  chronic atrophic form of, IV. 851
  complicating gynæcological surgery, IV. 493
  constitutional treatment of, I. 182
  Ludwig's angina, I. 183
  of the orbit, III. 661
  pelvic, IV. 822-838
    abscess cavities in, drainage of, IV. 832
    anti-streptococcus serum in, IV. 833
    diseases of pelvic bones in, IV. 836

Cellulitis, pelvic (*contd.*)—
  inflammation virulent in, IV. 847
  moderate acute infection in, IV. 827
  parametritis, chronic in, IV. 834
    remote in, IV. 833
  summary of treatment, IV. 837
  suppuration in, IV. 828
  vaccine treatment of, IV. 837
Centanni's method in rabies, I. 265
Cephalhæmatoma of newborn child, IV. 363
Cephalhæmatomata on head, injuries in the infant, I. 886
Cephalotribe, Auvard's three-bladed in craniotomy, IV. 408, 411
  difficulties of, IV. 409
  in craniotomy, IV. 408, 409
  merits of, IV. 410
Cerebellum, diseases of, in children, II. 1165-1166
  disorders of, II. 1246
Cerebro-spinal fluid, escape of, in spina bifida, I. 913
  meningitis, I. 250
  paraplegia, II. 1196
Ceresole-Reale spa, III. 149
Ceridine in boils, III. 1008
Cerumen, hypersecretion of, in the meatus, III. 884
Cervical auricle, III. 876
  forceps for post-partum hæmorrhage, IV. 221
Cervix uteri, acetone applied after curetting, I. 137
  adenomatous disease of, IV. 632-633
  amputation of, in prolapse of uterus, IV. 194, 199, 695
  atresia of, IV. 158, 712
    complicating labour, IV. 158
  cancer of, IV. 582-617
    acetone in, IV. 616
    appearance of early, IV. 585
    caustics for, IV. 616
    cauterisation in, IV. 615
    complicating labour, IV. 160
    curative treatment, IV. 584
    differential diagnosis in, IV. 589
    early diagnosis in, IV. 584
    fibroids of, IV. 159
    fulguration in, IV. 617
    leucorrhœa in, IV. 567
    ligature of arteries in, I. 136
    operative cure of, IV. 591
    palliative treatment, IV. 615
    preventive treatment, IV. 582
    radical abdominal operation in, IV. 601
    radical hystero-vaginectomy in, IV. 611
    radium in, IV. 615
    relief of symptoms in, IV. 617
    retardation of growth in, IV. 615
    signs established in, IV. 587
    symptoms of, IV. 585

Cervix, cancer of (*contd.*)—
    total abdominal hysterectomy in, IV. 600
    vaginal hysterectomy in, IV. 593
      after-treatment, IV. 596
      technique of operation, IV. 593
      Wertheim's operation in, IV. 601
  congenital hypertrophy of, IV. 716
  conical, IV. 713-716
  dilatation of, in dysmenorrhœa, IV. 762
    in forcible methods of delivery, IV. 442
    in induction of premature labour, IV. 439
    in sterility, IV. 854
  endometritis of, IV. 627
  erosion of, IV. 632-633
  fibroid of, anterior, hysterectomy in, IV. 651
    central, hysterectomy for, IV. 648
    polypus of, IV. 658
    posterior, hysterectomy for, IV. 652
  gonorrhœa of, leucorrhœa in, IV. 566
  hypertrophy of, IV. 700-706
  incision of, in eclampsia, IV. 40
  incomplete removal of, in vaginal hysterectomy, IV. 600
  inflammation of, acute, leucorrhœa in, IV. 566
    chronic, leucorrhœa in, IV. 566
  injuries of, IV. 707
  laceration of, severe, IV. 189
    sterility in, IV. 857
  leucorrhœa from, IV. 566
  mucous polypi of, IV. 567, 662
  podalic version in, IV. 468
  rigidity of, IV. 159
  stenosis of, IV. 715
  supra-vaginal portion, hypertrophy of, IV. 703, 705
  vaginal portion, amputation of in endometritis, IV. 630 ; hypertrophy of, IV. 700, 701
Chalazia of the eyelids, III. 578
Chalybeate waters, III. 122
  in chlorosis, II. 26
Championnière (Lucas), on massage in fractures, I. 578
  on fractures of clavicle, I. 584
Chancre, syphilitic, I. 316
  of the tongue, II. 134
  soft, I. 315
Chantemesse's serum in typhoid fever, I. 347
Chapman on diet in tuberculosis, II. 203
Chappa, III. 466
Charcot's disease of joints, I. 785
Charles (Sir R. H.), elephantiasis scroti, III. 504-516
  sunstroke, I. 536-539
Charwomen's dermatitis, III. 1030
Châtel Guyon spa, III. 149
Chaulmoogra oil in leprosy, III. 449
Cheatle (G. L.), on extension of rodent ulcers, I. 123
  surgical technique, I. 71-92

Cheese, chemical composition of, II. 194
Cheiropompholyx, III. 1015-1016
Cheloid or acne cheloid, III. 1018
Cheloids, causes and treatment of, I. 113
  of the scalp, I. 893
" **Chelsea Pensioner**," in rheumatism, I. 490
Cheltenham spa, III. 149
Chemotherapy, general principles of, III. 417
Chest,
  -clapping exercise in pulmonary diseases, III. 252
  contusions of, I. 1025
  deformities of, due to incorrect breathing, I. 50
  empyema following injury to, I. 1027
    generalised in the lower part of, I. 1101
  expansion exercises for spinal curvatures, III. 237
  foreign bodies in, I. 1027
  injuries of the contents of, I. 1028-1031
  new growths of, I. 1034
  penetrating gunshot wounds of, I. 564
  stab wounds of, II. 253
  voice production and, III. 333
  wounds of, I. 1025-1028
Cheyne's (Sir Watson), operation for malformation of the nose, III. 674
Chian turpentine in cancer, I. 148
Chianciano spa, III. 149
Chicken-pox, malignant form of, I. 185
  prophylaxis of, I. 186
  treatment of, I. 186
Chilblains, III. 1019-1020
Child, newborn. *See* Infants.
Children, acute appendicitis in, II. 405
    bronchitis in, I. 1052
    rheumatism in, I. 268, 271
  ailing, anæmia in, II. 14
  antiflexion of uterus in, IV. 670
  asthma in, I. 1041
  baths for, directions as to, I. 47
  brain tumours in, II. 1166
  care of, I. 44-70
    the digestion in, I. 45
    the feet in, I. 57
  cerebellar conditions in, II. 1165-1166
  clothing of, directions as to, I. 50 ; IV. 339
  colic in, II. 428-431
  constipation in, II. 432-438
  contra-indications to excisions in, I. 770
  control of the bladder and bowels in, I. 53
  cookery for, directions for, I. 59
  deafness in, causes of, III. 979
    educational treatment of, III. 981
    surgical treatment of, III. 980
  diarrhœal diseases of, II. 471-478
  dietary suitable for, I. 58-81 ; II. 202
  digestive system of, derangements of, causes of, I. 64
Children (*contd.*)—
  diseases of, external applications in, I. 69
  dosage of medicines for, I. 66
  exercises for, I. 51, 57
  fat, not always healthy, I. 59
  fatigue in, to be avoided, I. 56
  foreign bodies in the ear of, III. 889
  gonorrhœal salpingitis in, IV. 807
  " hardening " of, danger of, I. 46, 50
  hip joint, disease in, I. 754
  hygiene of, I. 44-70
  laryngeal spasm in, III. 827-830
  management of, during anæsthetics, III. 25
  multiple papillomata in, III. 851
  muscular atrophy in, family form of, II. 1247
  ponos in, III. 440
  postures of, I. 56
  premature, treatment of, IV. 372
  pyelitis in, II. 805
  rest for, I. 56
  rheumatism in, I. 276-279
  sleep of, amount required, I. 54
  tetany in, II. 1272-1273
  tumours of the kidney in, II. 836
  vulvitis in, IV. 560
  vulvo-vaginitis in, IV. 528, 560
  See also Infants.
Chill, avoidance of, after baths and packs, I. 38
    in infants and children, I. 46, 50, 52, 53
  and food fever, II. 236
Chinosol in syphilitic ulcers, II. 136
Chittenden on food values, I. 450
  on over-nutrition, I. 451
Chittenden's diet tables, II. 200
Chloasma, III. 1017
Chloral in diseases of the heart, I. 1225
  hydrate in asthma, I. 1040
    in epilepsy, II. 996
    in restlessness of fever, I. 244
    poisoning, treatment of, I. 530
    use of, in diseases of children, I. 67
  in morphinism, I. 518
Chloralamide in insomnia, I. 366
  of scarlet fever, I. 286
  in simple insomnia, I. 159
Chloretone in children's diseases, I. 67
Chloride in opacity of the cornea, III. 572
  of sodium, ionisation with, I. 488
Chlorine in typhoid fever, I. 354
  ions, III. 184
  solution, mouth wash of, I. 285
Chloroform, anæsthetic mixtures with, III. 19
  as anæsthetic, III. 13
  in convulsions, I. 292
  in eclampsia, IV. 36
  inhalation of, in aortic aneurysm, I. 1299

hloroform (*contd.*)—
  Junker's inhaler for administration of, III. 16
  poisoning, delayed, in fatty liver, II. 669
    treatment of, I. 531
hloroma of the bones of the skull, I. 895
hlorosis, II. 20-31
  arsenic in, II. 27
  baths for, II. 26
  chalybeate waters in, II. 26
  constipation in, II. 30
  diet in, II. 29
  digitalis in, II. 27
  emetics in, II. 28
  general principles in, II. 20, 30
  intestinal antiseptics in, II. 28
  iron preparations in, II. 21
  manganese in, II. 27
  marriage and, II. 31
  mineral waters and baths in, III. 143
  organic iron compounds in, II. 24
  quinine in, II. 27
  rest in, II. 20
  salt in, restricted, II. 28
  scale preparations in, II. 24
  spas for, II. 26
  sulphur in, II. 27
  sunshine in, II. 20
  theocin-sodium acetate in, II. 27
  wines in, II. 25
Cholangiostomy, intrahepatic, I. 144
Chlorotic thrombosis, I. 1331
Cholangitis, II. 701
  infective, II. 704
  suppurative, II. 705
Cholecyst-enterostomy in biliary cancer, I. 143
  in cholelithiasis, II. 694, 695
Cholecystitis, catarrhal, II. 700
  obliterative, II. 701
  phlegmonous, acute, II. 704
Cholecystostomy in biliary cancer, I. 143
  for cholelithiasis, II. 686, 693
Cholelithiasis, II. 682-685
  after treatment, II. 695
  biliary colic in, II. 684
  cholecystenterostomy in, II. 694, 695
  cholecystotomy for, II. 686, 693
  cholelithotrity and, II. 695
  diet in, II. 683
  enlargement of the pancreas and, II. 694
  general treatment, II. 682
  intermittent hepatic fever in, II. 684
  intervisceral fistula and, II. 695
  malignant disease and, II. 695
  prophylaxis of, II. 682
  spa treatment of, II. 683
  surgical treatment of, II. 686-697
Cholelithotrity and cholelithiasis, II. 695
Cholera, III. 423-427
  anti-choleraic vaccination of, III. 423
  convalescence in, III. 427
  diseases of the intestines in, III. 425
Cholera (*contd.*)—
  personal hygiene in, III. 424
  prophylactic measures in, III. 423
  stage of collapse in, III. 426
    invasion in, III. 425
    reaction in, III. 427
  treatment of an attack of, III. 425
    diarrhœa in, III. 425
    discharges in, III. 427
  vaccine therapy in, III. 273
Cholesteatoma, III. 934
Chondrodystrophia fatalis, II. 1227
Chondroma of the scalp, I. 893
Chopart's disarticulation at the mid-tarsal joint, I. 840
  operation, comments on, I. 842
    disarticulation in, I. 842
    flaps in, I. 842
    incision in, I. 842
    indications for, I. 840
    superficial landmarks in, I. 841
Chordee and painful erections of the penis complicating gonorrhœa, I. 226
Chorea, II. 1257-1263
  blistering in, II. 1262
  care of the bowels in, II. 1261
  convalescence of, II. 1262
  diet in, II. 1261
  Huntingdon's, II. 1249
  hypnotism in case of, III. 174
  in children, ergot in, I. 68
  massage in, II. 1263
  medicinal measures in, II. 1257
  nursing in, II. 1262
  rest in, II. 1260
  spa treatment in, II. 1263
  special baths in, II. 1263
Chorea gravidarum, complicating pregnancy, IV. 51
Chorio-carcinoma of the uterus, IV. 618-619
Chorion-epithelioma of Fallopian tube, IV. 804
  of the uterus, IV. 618-619
Choroid, diseases of, III. 597
  rupture of, III. 597
  tumours of, III. 597
Choroiditis, III. 597
Chromidrosis, or coloured sweating, III. 1021
Chrysarobin in alopecia areata, III. 995
  in psoriasis, III. 1117
Chyluria in filariasis, III. 503
  (non-parasitic), II. 752
Cicatricial œdema of larynx, III. 863-876
Cicatrix, formation, after amputation, I. 793, 795
Cider in gout, I. 457
Ciliary body, diseases of, III. 583, 592-596
  inflammation of, III. 592
    vitreous opacities in, III. 593
  paracentesis of anterior chamber, III. 593
  tumours of, III. 596

Cinchona in alcoholism, I. 501
Circulation, disorders of, Zander treatment in, III. 371
  enfeebled, cerebral thrombosis due to, II. 1178
  intra-cranial venous, vascular tumours in communication with, I. 894
Circulatory system, diseases of, climate for, III. 97
  electro-therapeutics in, III. 109
  massage and the, III. 209
Circumcision, II. 880-881
Circumflex nerve, injuries of, II. 1111
Cirrhosis hepatic, II. 631
Citrated milk, II. 225
Citrates in influenza, I. 223
Clamp for hæmorrhoids, II. 619
Clarke (Ernest), errors of refraction and accommodation, III. 528-542
Claudication, intermittent, II. 1234-1236
  serum treatment of, II. 1235
Claustrophobia in psychasthenia, II. 1044
Clavicle, dislocation of, I. 714
  fractures of, I. 583, 680
    in newborn child, IV. 354, 366
  resection of in Berger's operation, I. 831
Cleaves (Margaret), on "light energy," III. 191
Cleft palate, II. 147-156
Cleidotomy in contracted pelvis complicating labour, IV. 171
  in craniotomy, IV. 412
Climate, conditions unfavourable for abdominal operations, II. 257
  diseases induced by, I. 5
  effect of, in dietetics, II. 200
  for anæmia, III. 92
  for arthritis deformans, I. 392
  for asthma, I. 1037
  for Basedow's disease, III. 99
  for catarrh of upper air passages, III. 101
  for diabetes, III. 96
  for diseases of the circulatory system, III. 97
    of digestive system, II. 351 ; III. 98
    of the heart, III. 97
    of the kidney, III. 101
  for exophthalmic goitre, III. 99
  for gout, III. 93
  for Graves's disease, III. 99
  for nervous ailments, III. 99
  for obesity, III. 92
  for rheumatism, III. 94
  for rheumatoid conditions, III. 94
  for rickets, III. 96
  for tuberculosis, III. 100
  in atony of the stomach, II. 289
  in chronic bronchitis, I. 1055
  in exophthalmic goitre, II. 56
  in gastric disorders, II. 351, 354, 360
  in gout and gouty conditions, I. 460
  in hypertrophic emphysema, I. 1083
Climate (*contd.*)—
  of tropics, adaptation of habits to, III. 376
  pulmonary tuberculosis and, I. 1118
Climates, classification of, III. 85
  tropical, varieties of, III. 375
  warm, diseases of, III. 375-516
  where heat demand is large, III. 88
    is medium, III. 87
    is small, III. 86
  See also Tropical diseases, *and* Tropics.
Climatic bubo, III. 467
  demand, law of, in climatology, III. 71
Climatology, III. 69-102
  climatic requirements in disease and, III. 91
  law of climatic demand in, III. 71
      individual response in, III. 78
      local requirement in, III. 83
Clinical phenomena of disease, I. 15
Clitoris, hypertrophy of, IV. 514
Clothing, disinfection of, I. 161
  during pregnancy, IV. 8
  faulty, in spinal curvatures, III. 236
  for infants and children, I. 50 ; IV. 339
  in abdominal operations, II. 260
  in arthritis deformans, I. 393
  in chronic bronchitis, I. 1055
    rheumatism, I. 485
  in rickets, I. 478
  in the tropics, III. 377
Clover's crutch for retained placenta, IV. 232
  in lacerations of the genital tract, IV. 188
  inhaler, Hewitt's modification of, III. 7
Club-foot, bar on outside edge of sole and inside brace for, I. 954
  case of neglected, I. 956
  congenital, I. 951
  shoe, I. 953
Coagulation, locally, encouragement of. in hæmophilia, II. 32
Coal-tar derivatives in typhoid fever, I. 352
Cocaine in whooping cough, I. 311
  poisoning by, I. 532
Cocainisation, for foreign bodies in air passages, III. 816
Cocainism, I. 505, 532
Coccydynia or coccygovynia, I. 900, 921
Coccyx, contusions of, I. 900
  fracture of, I. 608
Cochlea, removal of, operation for, III. 973-974
Cocoa, chemical composition of, II. 197
  in typhoid fever, I. 343
Codeine in constipation in adults, II. 446
  in diabetes insipidus, I. 429
    mellitus, I. 424
Cod-liver oil, dosage of, for children, I. 66
  in rickets, I. 479
  inunction of, I. 70
Cœliac disease, II. 426-427
Coffee as antidote in poisoning, I. 530, 532, 534
  in typhoid fever, I. 343

Coin catchers, II. 185
Colchicine pills in gout, I. 433, 435
  poisoning by, treatment of, I. 533
Colchicum in gout, I. 433, 435
  poisoning by, I. 533
Cold, exposure to, cause of rheumatism, I. 277, 279, 484
  in hæmorrhage, I. 1260
  in sprains, I. 737
  protection from, necessary to young children, I. 50
Cold baths for children, directions as to, I. 47
    in eclampsia, IV. 37
    in typhoid fever, I. 348
    use of, I. 36
  pack in cutaneous inelasticity, I. 69
    use of, I. 37
  sponging in fever, I. 244
    in hyperpyrexia, I. 160
Colds. *See* Catarrh.
Colectomy in constipation in adults, II. 468
Coley's fluid, dosage of, III. 298
  in cancer and sarcoma, I. 152
  in epithelioma of tongue, II. 144
  in inoperable sarcoma, I. 920
  in malignant tumours, III. 298
  in sarcoma of jaw, II. 118
  prophylactic use of, I. 130
Coli-bacilluria in anæmia, II. 14
Colic, biliary, and cholelithiasis, II. 684
  from foods containing curds, II. 231
  in children, II. 428-431
  in lead poisoning, I. 512
  renal and calculus, II. 755
Colitis, II. 562-569
  chronic mucous, II. 570
    mucous, appendicostomy for, II. 571
      cæcostomy in, II. 571
      valvular cæcostomy in, II. 571-573
  complicating gastroptosis, II. 321
  hæmorrhagic, II. 574
  membranous, II. 563
  surgical treatment of, II. 570
  ulcerative, II. 568, 576
    diet in, II. 211
    in mercurial poisoning, I. 530
Collapse and anæsthetics, III. 24
  cause of, I. 94
  following sudden suppression of drugs, I. 516
  in abdominal injuries, II. 244
  in emergency cases of abdominal operations, II. 260
  in food poisoning, I. 509
  in marasmus, I. 467
  intravenous infusion in, I. 104
  mustard bath for, I. 38
  saline injections in, I. 33
  treatment of, I. 94, 104
Colles's fracture, I. 602
  of radius, I. 578
Collier (James), aphasia and other speech defects of cerebral origin, I. 1143-1149
Collier (James) (*contd.*)—
  apraxia, II. 1150-1152
  migraine and other forms of periodic headache, II. 1027-1035
  treatment to facilitate restoration of speech faculties by functional compensation, II. 1049-1051
Collodion, dressing with, method of, I. 89
  flexile, use of, in bedsores, I. 911
  in small-pox, I. 305
  in wounds, I. 552
Colon, abnormalities of, chronic constipation due to, II. 470
  adhesions of, II. 559
    non-operative treatment in, II. 559
    operative treatment, II. 560
  bacillus peritonitis, II. 641
  cancer of, II. 578-584
    cæcostomy for, II. 584
    colotomy for, II. 581
    excision of growths in cæcal region, II. 580
    immediate anastomosis in, II. 579
    left inguinal colotomy for, II. 581
    lumbar colotomy in, II. 583
    palliative operations for, II. 580
    Paul's operation for, II. 580, 584
    relief of obstruction in, I. 141
    resection of the growth, II. 579
    short-circuiting operation for, II. 580
  congenital abnormalities of, II. 585
    dilatation of, II. 585
      acute obstruction in, II. 585
      colotomy for, II. 586
      non-operative treatment, II. 585
      operative treatment, II. 586
      resection in, II. 586
    hypertrophy of, II. 585
  diseases of, II. 559-592
    chronic constipation due to, II. 470
    mineral waters and baths in, III. 139
  exclusion of, in constipation in adults, II. 468
  hyperplastic tuberculosis of, II. 590
  in enteroptosis, surgery of, I. 431
  multiple polypi of, II. 588
  perforation of, II. 558
    in pericolitis, II. 576
  tuberculosis of, II. 590
    ulcer of, with perforation, II. 589
  volvulus of, II. 591
    operation for shortening mesocolon in, II. 592
Colostomy in cancer of intestines, I. 141
Colotomy in cancer of the colon, II. 581
  in congenital dilation of the colon, II. 586
  left inguinal, for cancer of the colon, II. 581
  lumbar, in cancer of the colon, II. 583
Colpo-perineorrhaphy, posterior, in prolapse of uterus, IV. 694
Colporrhaphy, anterior, IV. 549
  in prolapse of uterus, IV. 694

Colpotomy in tubal pregnancy, IV. 87
Coma, II. 982-985
  alcoholic, II. 984
  associated with intra-cranial abscess and tumour, II. 983
  cerebral hæmorrhage and, II. 984
  diabetic, I. 424 ; II. 983
  epileptic, II. 983
  following morphia poisoning, II. 984
  in heat stroke, II. 985
  malarial, II. 985
  uræmic, II. 982
Combretum sundiacum in opium smoking, I. 518
Comedones, III. 1022-1023
  local procedure for, III. 1022
  of the auricle, III. 881
  Röntgen rays in, III. 1023
Complications and sequelæ of disease, I. 22
Compresses, changing of, I. 36
Conception, retention of products of, subinvolution of uterus by, IV. 721
Concretions of the stomach, II. 359
  See also Calculi.
Concussion of brain in cranial fractures, I. 877
Condiments in obesity, I. 472
Condurango in anorexia of gastric cancer, II. 298
Condylomata, acuminate, of the vulva, IV. 511
Congenital abnormalities of the colon, II. 585-587
  absence of the tympanic membrane, III. 891
  affections of the heart, I. 1254
  alopecia, III. 997
  amblyopia, III. 543
  amyotonia, II. 1245
  anteflexion of the uterus, IV. 670
  atresia of the meatus, III. 882
    pylorus, II. 344
  cystic disease of kidney in fœtus complicating labour, IV. 180
    goitre complicating labour, IV. 180
  defects of the newborn child, IV. 355-363
  dilatation of the colon, II. 585
  elevation of the shoulder, I. 985
  hydronephrosis, II. 772
  hypertrophy of cervix, IV. 716
    of the colon, II. 585
  malformations of the penis, II. 875-876
    of the umbilicus, II. 277
    of the ureter, II. 774
    of the vagina, IV. 541
  myotonia, II. 1252
  obliteration of the bile-ducts, II. 673
  perforations of the tympanic membrane, III. 891
  ptosis, III. 650
Congenital abnormalities (*contd.*)—
  syphilis in newborn child, IV. 369
    and jaundice, II. 672
  varix, I. 1310
  webs of the meatus, III. 882
Congestion, passive. *See* Bier's treatment.
Conjunctiva, burns of, III. 547
  diseases of, III. 547-562
    general rules in, III. 548
    prescriptions in, III. 548
  pterygium of, III. 561
  snow blindness of, III. 560
  spring catarrh of, III. 560
  symblepharon of, III. 548
  tuberculosis of, III. 560
  tumours of, III. 561
  wounds of, III. 547
  xerosis of, III. 561
Conjunctivitis, catarrhal, III. 551
  complicating influenza, I. 239
    small-pox, I. 309
  diphtheritic, III. 557
  electric, III. 560
  in measles, I. 246
  phlyctenular, III. 552
Connell (Arthur), diseases of the lymphatic glands, I. 1339-1340
  injuries of the spleen, II. 79-80
  lymphatic vessels, I. 1351-1352
  new growths of glands, I. 1350
  surgical treatment of spleen, II. 81
    of tuberculous glands, I. 1348
Connell (K.), on acid urine in typhoid fever, I. 346
Constipation after abdominal operations, II. 264
  and insomnia, II. 986
  and modifications of diet in simple digestive disorders, II. 231
  auto-intoxication and, I. 387
  chronic, appendicostomy for, II. 470
    due to abnormalities of the colon, II. 470
    due to disease of colon, II. 470
    ileo-sigmoidostomy for, II. 470
    massage in, III. 211
  complicating diabetes mellitus, I. 426
    typhoid fever, I. 358
    ulcer of the stomach, II. 381
  constitutional, II. 445
  cumulative, II. 445
  diet in, II. 212
  in adults, II. 439-469
    abdominal supports in, II. 462
    alkaloids in, II. 446
    amount of fluid for enemata in, II. 454
    castor oil in, II. 448
    choice and dosage of purgatives in, II. 445
    dietetic treatment of, II. 441
    electrical treatment, II. 464
    enemata in, II. 452, 457

- **Constipation** in adults (*contd.*)—
    - exercise in, II. 459
    - general indications for the use of enemata in, II. 457
    - glycerine suppositories in, II. 453
    - hydrotherapy in, II. 459
    - hygiene of the bowels in, II. 439
    - indications for purgatives in, II. 444
    - intestinal lavage in, II. 467
    - massage in, II. 462
    - medicinal treatment of, II. 444
    - mercurial purgatives in, II. 450
    - natural aperient waters in, II. 466
    - operative treatment of, II. 467
    - psychotherapy in, II. 441
    - removal of impacted fæces in, II. 452
    - saline purgatives in, II. 449
    - short-circuiting operations for, II. 467
    - spa treatment of, II. 465
    - substances which increase the bulk of the fæces in, II. 450
    - suppositories in, II. 452
    - Swedish gymnastics in, II. 459, 460
    - synthesised purgatives in, II. 449
    - varieties of enemata in, II. 454
    - vegetable purgatives in, II. 447
  - in amenorrhœa, IV. 726
  - in atony of the stomach, II. 287
  - in cancer of the stomach, II. 300
  - in children, II. 432-438
    - anal fissure in, II. 436
    - atonic dilatation of the bowel in, II. 435
    - local causes of, II. 434
    - overloaded condition of sigmoid in, II. 435
    - prevention of, II. 432
    - spasmodic contraction of sphincter ani in, II. 436
  - in chlorosis, II. 30
  - in general paralysis of the insane, II. 1079
  - in insomnia, II. 1018
  - in newborn child, IV. 368
  - in secretory disorders of the stomach, II. 363
  - intestinal, electricity in, II. 464
    - enemata in, II. 457
  - intractable, II. 445
  - mineral waters and baths in, III. 139
  - neurasthenic, electricity in, II. 465
  - senile, II. 445
  - symptomatic, II. 444
- **Constitution**, bodily, causes of weakness of, I. 5
- **Consumption**, pulmonary, I. 1117-1126
- **Contacts**, plague, III. 402
- **Contagious** diseases, disinfection of bedrooms during and after, I. 164
- **Contractions** following burns and scalds, I. 543
  - wounds, I. 555
- **Contrexéville** spa, III. 149
- **Contusions** and hæmatoma, I. 545-546
- **Convalescence**, cautions as to, I. 22
  - from acute rheumatism, I. 273
  - from anæmia, II. 15
  - from influenza, I. 235
  - from typhoid fever, I. 364
  - from whooping cough, treatment during, I. 384
  - in acute bronchitis, I. 1053
  - in chorea, II. 1262
  - in pernicious anæmia, II. 11
  - management of, I. 22
    - in children, I. 64
  - protracted, mineral waters and baths in, III. 146
  - quinine during, I. 65
- **Convulsions**, chloroform in, I. 292
  - in measles, I. 246
  - in newborn child, IV. 371
  - infantile, II. 986-989
    - rapidly repeated, II. 988
  - warm baths in, I. 70
- **Cookery** for children, directions for, I. 59
  - for the sick room, I. 42
- **Cooking**, effect on food, II. 198
- **Coolie** itch, III. 486
- **Cooper's** modification of Lisfranc's amputation, I. 840
- **Copper**, salts of, acute poisoning by, I. 529
- **Coracoid** process, fracture of, I. 586
- **Corn** preparations, chemical compositions of, II. 195
- **Cornea**, conical, III. 563
  - dermoid of, III. 563
  - diseases of, III. 563-573
  - herpes frontalis and, III. 571
  - interstitial keratitis of, III. 568
  - Mooren's ulcer of, III. 566
  - opacities of, III. 571
  - phlyctenular ulceration of, III. 567
  - rodent ulcer of, III. 566
  - sclerosing keratitis of, III. 570
  - tuberculous keratitis of, III. 569
  - ulcer of, III. 563
    - complicating small-pox, I. 309
  - vascular, keratitis of, III. 570
- **Corner (Edred M.)**, abdominal injuries, II. 242-256
  - peritonitis, II. 632-642
  - subphrenic abscess, II. 643-644
- **Cornflour**, preparation of, I. 42
- **Corns**, III. 1024-1025
- **Coronoid** process, fracture of, I. 598
- **Corpus** cavernosum, thrombosis of, I. 1331
- **Corrosive** poisoning, I. 526
- **Corrosives**, atrophy of stomach from ingestion of. II. 294
- **Corsets**, avoidance of, in gastroptosis, II. 319
  - for movable kidney, II. 789
- **Costo-transversectomy** in abscess in connection with tuberculous disease of the spine, I. 931
- **Cotton** goods, disinfection of, I. 161
  - wool jackets in bronchitis, I. 245

Cough and abdominal operations, II. 258
  extra-pulmonary in pulmonary tuberculosis, I. 1144
  in emphysema, I. 1087
  in measles, relief of, I. 245
  in pulmonary tuberculosis, I. 1144
  intermediate cause of, in pulmonary tuberculosis, I. 1146
  intra-pulmonary, I. 1147
  nervous laryngeal, III. 841
  relief of, in pleurisy, I. 1094
Counter-irritation in joint affections, I. 748
  of the spine in treatment of rheumatoid arthritis, I. 405-407
  use of, in children's diseases, I. 69
Cow-pox, Jennerian, I. 311
Cow's milk in infant feeding, II. 219
Coxa valga, I. 959
Coxa vara, I, 958
Cradling described, I. 37
Craft palsies, II. 1267
Craig (M.), cocainism, I. 505
  dementia præcox, II. 1305
  exhaustion psychoses, II. 1299-1300
  idiocy and feeble-mindedness, II. 1318-1320
  insomnia, II. 1014-1024
  mania, II. 1284-1289
  masturbation, II. 1316-1317
  melancholia, II. 1290-1298
  mental aspects of epilepsy, II. 1310-1312
  mental aspects of hysteria, II. 1306-1308
  mental diseases, II. 1274-1283
  morphinism, I. 516-520
  obsessive and imperative ideas, II. 1313-1314
  paranoia, II. 1309
  perversions, II. 1315
  psychoses associated with changes in thyroid gland, II. 1301-1302
  toxic psychoses, II. 1303-1304
Cramp, hammerman's, II. 1267
  telegraphist's, II. 1266
  writer's, II. 1264
    hypnotism in case of, III. 174, 175
Cranial bones, indentations of, in infants, I. 886
  meningocele, II. 1194
  puncture in hydrocephalus, II. 1191
Cranioclasm operation of, cranioclast in, IV. 407
Cranioclast, dangers of, IV. 409
  in craniotomy, IV. 406
  merits of, IV. 410
Craniotomy, IV. 403-412
  anæsthetic in, IV. 405
  Auvard's three-bladed cephalotribe in, IV. 410
  cephalotribe in, IV. 408, 409
    merits of, IV. 410
  cleidotomy in, IV. 412
Craniotomy (*contd.*)—
  cranioclast in, IV. 406
  crotchet in, IV. 411
  crushing in, IV. 406
  extraction in, IV. 406
    of after-coming head, IV. 412
    of the body in, IV. 411
  forceps in, IV. 411
  in breech presentation, IV. 406
  in brow presentation, IV. 405
  in face presentation, IV. 405
  in vertex presentation, IV. 405
  indications for, IV. 403
  instrumental crushing, IV. 406
  perforation in, 405
    dangers of, IV. 405
  version in, IV. 411
  vertebral hook in, IV. 411
Cranium. *See* Skull.
Craw-craw, III. 468
Cream in infant feeding, II. 227
Creams in pruritus, III. 1099
Creasy (Eliot) on static wave currents in arthritis, I. 746
Credé's method of expression in post-partum hæmorrhage, IV. 218
Cremation of infected material, I. 161, 164
Creosote as anti-pyretic, I. 352
  baths in bronchiectasis, I. 1044
  vapour bath in pulmonary tuberculosis. I. 1149
Cresolene vapour in whooping cough, I. 379
Cretinism and myxœdema, II. 72
Crico-arytenoid joint, III. 823
Crile's apparatus for use of ether administration, III. 27
Croft's splint, I. 629
  for fractures, I. 565
Crotchet in craniotomy, IV. 411
Croup in measles, I. 245
Croupous inflammation of the bile ducts II. 702
  of the gall bladder, II. 702
Crushing clamp for removal of the appendix, II. 414
Crypto-menorrhœa, IV. 732
Crystalline lens, delivery of, III. 626
  discission of in cataract, III. 611
  linear extraction of, III. 613
  operative treatment of, III. 611
  shrunken malformed, III. 607
  spoon delivery of, III. 628
Cubitus valgus at the elbow-joint, I. 938
Cudowa spa, III. 149
Cuff (H. E.) and **F. Foord Caiger**, diphtheria, I. 187-202
  general treatment of infectious diseases, I. 157-160
  scarlet fever, I. 281-294
  typhus fever, I. 365-367
Cunningham (H. H. B.), diseases and affections of the external ear, III. 876-889
  tympanic membrane, III. 891-893

Cupping, method of, I. 35
  glasses for hyperæmic treatment, III. 56
Curettage, after-treatment of, IV. 626
  application of acetone after, I. 137
  danger of, IV. 626
  in acute endometritis, IV. 621
  in chronic endometritis, IV. 622
  in menorrhagia, IV. 758
  in metrorrhagia, IV. 758
  leucorrhœa after, IV. 627
Curette evacuation of lens in lamellar cataract, III. 613
  flushing, IV. 621
  Roulte's pattern for retained placenta, IV. 227
  for cataract, III. 625
  loup, IV. 624
  narrow loup, IV. 625
  Roux's, IV. 624
Currents, high frequency and static in arthritis, I. 746
Curtains, disinfection of, I. 162
Cushing's method in cranial fracture, I. 882
Cushny on auricular fibrillation, I. 1232
  on drugs for diseases of the heart, I. 1212
Custards, preparation of, I. 42, 43
Cut throat, II. 164; III. 825
Cyanide gauze and wool, double, I. 75
  powder and paste, I. 74
Cyanides, poisoning by, I. 530
Cyanogen, percentage of, in cyanide gauze, I. 76
Cyclitis, III. 592
  traumatic, III. 595
yclophoria of ocular muscles, III. 648
ycloplegia, III. 534
yllin in gastric dilatation, II. 315
ysticercosis, III. 522
ystinuria, II. 734
ystitis, II. 858-860
  acute, II. 858
  chronic, II. 859
  omplicating adenoma of the prostate, II. 944
  gonorrhœa, I. 228
  gynæcological surgery, IV. 496
  the puerperium, IV. 272
  bilharzia disease, III. 500
  female, IV. 881-883
  injuries of the spine, I. 909
  myelitis, II. 1217
  pregnancy, IV. 272
  the puerperium, IV. 273
  neral waters and baths in, III. 140
  erculous, II. 861-863
  omplicating pulmonary tuberculosis, I. 1156
  rimary source of infection in, II. 861
  accine therapy in, II. 860
Cystocele of the vagina complicated by ulceration, IV. 547
  operative treatment, IV. 549
  palliative treatment of, IV. 547
  of uterus, surgical treatment of, IV. 693
Cystostomy in carcinoma of the bladder, II. 873
  in vesical cancer, I. 143
Cystotome for cataract, III. 625
Cystotomy, suprapubic for calculus in female bladder, IV. 877
Cysts and bursæ in association with arthritis, I. 749-750
  dental, of the gums, III. 1193
  dentigerous, of maxillary alveolus, III. 719
  of the auricle, III. 879
  of the breast, II. 952-954
  of lingual tonsils, III. 762
  of muscle, II. 1325
  of the neck, II. 167
  of the scalp, I. 892
  of the vagina, IV. 531-532
  of the vulva, IV. 511
  sebaceous, III. 1140
  surgical treatment of, I. 108-111

Daily notes in sanatorium treatment of pulmonary tuberculosis, I. 1132-1142
Dakin (**W. R.**), accidental hæmorrhage during pregnancy, IV. 23-29
  placenta prævia in pregnancy, IV. 65-69
Damp, cause of chronic rheumatism, I. 484
Daniels (**C. W.**), beri-beri, III. 414-416
  blackwater fever, III. 386-389
  chronic dysentery, III. 433-436
  dengue fever, III. 390
  epidemic dropsy, III. 416
  Japanese river fever, III. 390
  kala azar, III. 391
  malaria, III. 392-398
  Malta fever, III. 399-400
  phlebotomus fever ("sand fly" fever), III. 400
  relapsing fevers, I. 266-267
  undefined tropical fevers, III. 410-411
  yellow fever, III. 412-413
Darier's disease, III. 1026
Davos, climate of, III. 84
Dax spa, III. 149
Dead, disposal of, I. 164
Deaf-mutism, III. 979-981
  diagnosis of, III. 980
  pathology of, III. 979
  prognosis of, III. 980
Deafness, due to disturbance of cochlea division of eighth nerve, III. 977
  hysterical, and the labyrinth, III. 968
  in adults, educational treatment of, III. 981
  in children, causes of, III. 979
    educational treatment of, III. 981
    surgical treatment of, III. 980
  in otosclerosis, III. 956

Decapitation, fœtal difficulties of, IV. 415
  in contracted pelvis, IV. 415
  operation of, steps of, IV. 413
  sepsis in, IV. 415
Deciduoma malignum of the uterus, IV. 618-619
Decortication of lung in empyema, I. 1108
Deformities, acquired, of the lips, II. 96
  of the lower limb, I. 958-970
    after amputation in disease of the ankle and tarsus, I. 774
    after excision of the knee-joint, I. 771
    due to spinal and nerve paralysis, I. 988-990
    in tuberculous disease of the hip-joint, I. 759-761
      of the knee-joint, I. 767, 769
  of the upper limb, I. 935-943
  rachitic, I. 970-972
  recuperative factors in, I. 11
Degeneration, amyloid, I. 462
Deglutition in diphtheritic paralysis, I. 201
Delirium in typhoid fever, I. 362
  tremens in chronic alcoholism, I. 499
Delstanche's malleus extractor, III. 915
  otomasseur, III. 952
Dementia præcox, II. 1305
Dengue fever, III. 390
Dent (C. T.), obstruction of the intestine, II. 528-540
Dental cysts of the gums, III. 1193
  forceps, III. 1180-1187
  neuralgia, II. 1114
  surgery, III. 1164-1194
Deny's bouillon filtré tuberculin, III. 293
Deodorants, definition of, I. 161
Depilatories in hypertrichosis, III. 1047
Dermatitis artefacta, III. 1027
  blastomycetic, III. 1005
  following external applications, I. 486
  herpetiformis, III. 1028
  occupation, III. 1029
  phlegmonous, of the auricle, III. 881
  seborrhœic, III. 1004, 1143
  X-ray, III. 1161
    preceding cancer, I. 117
Dermatophiliasis, III. 481
Dermatosis, chronic, preceding cancer, I. 116
Dermoid cysts, I. 109
  of the auricle, III. 879
  of the cornea, III. 563
  of floor of mouth, II. 145
  of neck, II. 168
  of the scalp, I. 892
  of the tongue, II. 145
Desmoid fibroma, I. 113
Desquamation, infectivity of, I. 288
De Wecher's forceps scissors for traumatic cataract, III. 639
Dextrocardia in newborn child, IV. 361
Dhobie's itch, III. 478
Diabetes and anæsthetics, III. 24
  cancer complicating, I. 128
Diabetes (*contd.*)—
  climate for, III. 96
  coma in, II. 983
  complicating cancer of the breast, II. 966
    pulmonary tuberculosis, I. 1158
  drugs in, I. 423
  gangrene in, I. 217
  in gout and gouty conditions, I. 446
  insipidus, I. 428-429
    complicating pregnancy, IV. 55
    drugs in, I. 428-429
    general treatment of, I. 428
    polyuria of, I. 428
    prophylaxis of, I. 428
  mellitus, I. 408-427
    alcohol in, I. 423
    alkalies in, I. 423
    coma of, I. 424
    complicating pregnancy, IV. 54
    complications of, I. 425-427
    constipation in, I. 426
    dietetic and hygienic treatment of, I. 409
    exercise in, I. 422
    gangrene complicating, I. 426
    nephritis complicating, I. 426
    oatmeal treatment of, I. 421
    opium in, I. 424
    pregnancy in, I. 425
    prophylaxis of, I. 408
  neuritis in, II. 1131
  ulcers complicating, I. 373
  xanthoma in, III. 1160
Diabetic foods, I. 414, 419
  mastoiditis, III. 932
Diacetic acid in urine in diabetes, I. 409, 417
Diaphoresis in ascites, II. 628
Diaphragm, absence of half of, in newborn child, IV. 361
  rupture of, I. 1028
  wounds of, II. 253
Diaphragmatic hernia, I. 1028
Diarrhœa, acute in adults, II. 479
  caused by mushroom poisoning, II. 480
  chronic in adults, II. 480
  complicating diabetes mellitus, I. 426
    sprue, III. 445
    tuberculous peritonitis, II. 645
    typhoid fever, I. 358
  in children, II. 471-478
    lienteric form of, II. 477
  in cholera, III. 425
  in food poisoning, I. 509
  in measles, I. 246
  in pellagra, I. 522
  in pernicious anæmia, II. 4
  infantile, acute summer, II. 473
    preventive treatment of, II. 472
  of the hills, III. 438
  septic, in children, baths in, I. 69
Diet for infants and children, I. 58-61
  errors of, in anæmia, I. 14

Diet (*contd.*)—
- in acute bronchitis, I. 1051
  - dysentery, III. 429
  - endocarditis, I. 1191
  - fevers, II. 202
  - gout, I. 434
  - rheumatism, I. 270
- in amœbic dysentery, III. 430
- in arterio-sclerosis, I. 1290
- in arthritis deformans, I. 393
- in ascites, II. 626
- in asthma, I. 1036
- in atony of the stomach, II. 289
- in broncho-pneumonia, I. 1068
- in calculous disease, II. 207, 753
- in cancer of the stomach, II. 297
- in childhood, II. 202
- in chlorosis, II. 29
- in cholelithiasis, II. 683
- in chorea, II. 1261
- in chronic bronchitis, I. 1055
  - diffuse parenchymatous nephritis, II. 794
  - dilatation of the stomach, II. 313
  - gastritis, II. 350
  - gout, I. 455
- in constipation, II. 212
  - in adults, II. 441
- in diabetes mellitus, I. 409
- in diarrhœal diseases in children, II. 474
- in diphtheria, I. 188
- in disease, II. 202
- in diseases of the heart, I. 1206
  - of the intestines, II. 208
  - of the stomach, II. 208
- in eczema, III. 1032
- in epilepsy, II. 999
- in exophthalmic goitre, II. 55
- in gastric neurasthenia, II. 355
- in gastroptosis, II. 320
- in gout, II. 207
  - alimentary tract factors, I. 450
  - animal food, I. 451
  - articles to be avoided, I. 455
  - digestibility of food, I. 448
  - fruits in, I. 454
  - general principles, I. 447
  - meals, selections for, I. 455
  - purin-free, I. 452
  - saccharine food, I. 453
  - starchy food, I. 453
- in gouty conditions, I. 446
- in gynæcological surgery, IV. 488
- in hæmophilia, II. 35
- in hæmorrhoids, II. 616
- in hill diarrhœa, III. 438
- in infectious diseases, I. 158
- in inflammation of the stomach, II. 345
- in jaundice, II. 671
- in later infancy, II. 231
- in marasmus, I. 465
- in measles, I. 244
- in melancholia, II. 1292
- in membranous colitis, II. 566

Diet (*contd.*)—
- in myelitis, II. 1216
- in nephritis, II. 204
- in normal puerperium, IV. 269
- in obesity, I. 470, 472 ; II. 212
- in osteo-arthritis, I. 400
- in pericarditis, I. 1180
- in peritonitis, II. 640
- in pernicious anæmia, II. 2
- in plague, III. 403
- in pleurisy, I. 1094
- in pregnancy, IV. 6
- in psoriasis, III. 1110
- in pulmonary tuberculosis, I. 1119
- in rheumatism (chronic), I. 486
- in rickets, I. 479
- in scarlet fever, I. 283
- in scurvy, I. 475
- in secretory disorders of the stomach, II. 361
- in simple digestive disorders, constipation and, II. 231
- in sprue, III. 442-443
- in treatment of contracted pelvis in labour, IV. 174
- in the tropics, III. 378
- in tuberculosis, II. 203
- in typhoid fever, I. 340 ; II. 202
- in typhus fever, I. 366
- in ulcer of the stomach, II. 376
- in ulcerative stomatitis, II. 122
- in whooping cough, I. 379
- modifications of, in simple digestive disorders, II. 230
- purin-free, in epilepsy, II. 1000
- regulation of, before abdominal operations, II. 258
- tables of, for diabetics, I. 414
- vomiting and, II. 231

Dietary, sick room, I. 42

Dietetics, principles of, II. 190-213
- proportion of different foods in, II. 200

Diets, Chittenden's tables of, II. 200

Dieulafoy on surgical treatment of hæmatemesis, II. 332

Digestion, aids to, II. 289, 291, 315, 322
- care of, in infants and children, I. 45
- disorders of, due to excessive drugging, I. 64
  - electro-therapeutics in, III. 110
  - massage and, III. 211
  - modifications of diet in, II. 230
  - symptoms of, II. 370-374
    - in rickets, I. 479
- milk as a cause of disorders of, I. 61

Digestive organs, disorders of, massage and, III. 211
  - Zander treatment in, III. 372
- system, climate for, III. 98
  - effect of excess of food on, I. 8

Digitalis in arterio-sclerosis, I. 1294
- in chlorosis, II. 27
- in diseases of the heart, I. 1213
- in exophthalmic goitre, II. 55
- in heart failure, I. 260

Digitalis (*contd.*)—
  method of administration of, I. 1219
  poisoning by, I. 533
  preparations of, I. 1219
Digits, supernumerary, in newborn child, IV. 363
  union of, in newborn child, IV. 362
Dilatation, therapeutic significance of, I. 14
Dilating bag, use of, in accidental hæmorrhage during pregnancy, IV. 25
Dilator, glass, in vaginismus, IV. 862
  graduated metal, IV. 623
  for retained placenta, IV. 226
  modified Sims', IV. 623
Dionin in iritis, III. 586
Diphtheria, I. 187-202
  acute inflammation of middle ear in, III. 902
  age as a factor in, I. 190
  antitoxin treatment of, I. 189-192
    dosage of, I. 190 ; III. 275
    intravenous injection of, I. 191
    method of administration, I. 191
    prophylactic use of, I. 192
    sequelæ of, I. 193
    standardisation of, III. 274
    therapeutic value of, III. 276
    value of, in prophylaxis, III. 279
  bacterio-therapeutics of, III. 273-279
  bacteriology of, I. 188, 189
  complications of, cardiac, I. 199
    effect of anti-toxin in, III. 278
    otitis media, I. 202
    paralysis, I. 200
    pregnancy, IV. 49
    renal affections, I. 201
  conjunctivitis in, III. 557
  diet in, I. 188
  drugs in treatment of, I. 193
  general management of, I. 187
  hæmorrhagic, I. 187, 199
  isolation in, duration of, I. 187
  laryngeal, I. 194-199
    intubation in, I. 198
    tracheotomy in, I. 195
  local treatment of, I. 193
  measles associated with, I. 243
  nasal discharge in, I. 190
  neuritis after, II. 1138
  of the meatus, III. 883
  of the vulva, IV. 523
  remedial treatment of, I. 189-194
  return cases of, I. 188
  serum, dangers and ill-effects of, III. 297
    limitations of, III. 300
  stimulants in, use of, I. 193
Diplopia, paralytic, of ocular muscles, III. 649
Dipsomania, I. 497
  pseudo-, I. 498
Discission needle for cataract, III. 611
Disease, acute, I. 20
    indications for treatment, I. 20
  causes of, complexity of, I. 6
    control of, I. 3
    specific, avoidance and removal of, I. 6, 7
      natural reaction to, I. 8
  chronic, I. 21
    indications for treatment, I. 20
  climatic requirements in, III. 91
  clinical phenomena of, I. 15
  complications and sequelæ of, I. 22
  diet in, II. 202
  incipient, mineral waters and baths in, III. 146
  insect-borne, protection from, in the tropics, III. 379
  intercurrent complicating pernicious anæmia, II. 11
  local, of obscure origin, III. 465-469
  malignant, X-rays in, III. 362
  natural resistance to, I. 3, 5
  prevention of, methods of, I. 4
  principles of the treatment of, I. 1-25
  processes of, conservative, I. 10
  specific causes of, I. 4
  terminations of, I. 21
  X-ray treatment of, III. 360-368
Disinfectants, definition of, I. 161
  for typhoid cases, I. 339
  poisoning by, I. 527
Disinfection by spraying, I. 163
  in amputations, I. 797
  in plague, III. 401, 402
  of bedrooms during and after contagious complaints, I. 164
  of clothes, I. 161
  of leather goods, I. 162
  of premises, I. 162
  of stools, I. 164
  of utensils, I. 40
  preparatory to operation, methods of, I. 27, 30
  with hot air, I. 162
    See also Sterilisation.
Dislocations, I. 713-733
  congenital, of the elbow, I. 936
  in newborn child, IV. 366
  nerve injuries, complicating, II. 1102
  of ankle and foot, I. 731-733
  of the clavicle, I. 714
  of the elbow, I. 721
  of the fingers, I. 723, 938
  of the head of the radius, I. 936
  of hip, I. 724, 943
  of the jaw, II. 104
  of the knee, I. 728, 949
  of the shoulder-joint, I. 715, 935
  of the spine, I. 902-905
  of the teeth, III. 1177
  of the ulnar nerve, II. 1113
  of the wrist, I. 723, 937
  reductions of, anæsthetics for, III. 33

Distension, flatulent, complicating gynæcological surgery, IV. 490
Diuretic waters, III. 120
Diuretics in ascites, II. 627
Diver's paralysis, I. 1306
Diverticula, of the œsophagus, II. 189
  vesical, II, 864
Dixon (W. E.) on drugs in hæmorrhage, I. 1261
Dobbie (Nina L.), physical exercises, III. 257
Döderlein's method of pubiotomy, IV. 448, 449
Dominici (H.), radium therapy, III. 303-315
Dominici's tubes in radium therapy, III. 305
Donovan's solution in syphilis, I. 321
Dosage of medicines for children, I. 66
Douche bath, III. 127
    for infants and children, I. 48
    sub-thermal, III. 127
  hot-air, in hyperæmic treatment, III. 65
  in chronic synovitis and arthritis, I. 746
    in menorrhagia, IV. 756
    in metrorrhagia, IV. 756
  in puerperal sepsis, IV. 310-311
  in retroversion of the uterus, IV. 673
  in vaginal leucorrhœa, IV. 561
  Scotch, in gouty joints, I. 439
  tube, intra-uterine, IV. 298
  vaginal, I. 39
Douglas, pouch of, in posterior cervical fibroid, IV. 652
Dover's powder in pneumonia, I. 259
  in sleeplessness, I. 159, 186
Dowsing radiant heat bath, I. 747
Doyen's gag, III. 735
  serum in cancer, I. 152
Doyne (R. W.), amblyopia and functional diseases of the eye, III. 543
  diseases of the choroid, III. 597
    of the conjunctiva, III. 547-562
    of the optic nerve, III. 645
    of the orbit, III. 661-663
    of the retina, III. 642-644
  glaucoma, III. 602-606
  injuries of the eyeball, III. 656—660
Dracontiasis (infection by guinea-worm filaria medinensis), III. 501
  prophylaxis of, III. 501
Drainage of the pericardium, I. 1188
  of wounds, I. 551
    after amputation, I. 802
  surgical, methods of in acute abscess, I. 167, 170
  tubes, cyanide gauze to be used with, I. 80
  See also Lumbar puncture.
Draughts, avoidance of in nurseries, I. 45
  with young children. I. 52
Dressings after abdominal operations, II. 266
  application of, I. 86
Dressings (*contd.*)—
  in burns and scalds, I. 541, 548
  in gynæcological surgery, IV. 488
  in ovariotomy, IV. 804
  in wounds, I. 554
  of wounds after amputation, I. 802
  surgical choice of materials for, I. 79
    materials for, I. 74-80
Drink, cold water, in fevers, I. 158
  imperial, composition of, I. 258
  in the tropics, III. 378
  in typhoid fever, I. 343
Droitwich spa, III. 150
Dropped finger, II. 1329
Dropsy due to heart failure, digitalis in, I. 1220
  epidemic, III. 416
  of the gall bladder, II. 710
Drowsiness, condition of, and anæsthetics, III. 23
Drug eruptions, III. 1031
Drugs after abdominal operations, II. 270
  allied narotic, use of and anæsthetics, III. 22
  anti-pyretic, in typhoid fever, I. 351
  antiseptic, in plague, III. 406
  collapse following sudden suppression of, I. 516
  diabetes mellitus, I. 423
  dosage of, for children, I. 66
  during pregnancy, IV. 9
  hypnotic, I. 500
    in insomnia, II. 1021
  impotence due to use of, I. 231
  in acute catarrhal pharyngitis, III. 766-767
    diarrhœa in adults, II. 480
    dysentery, III. 429
    laryngitis, III. 833
    nephritis, II. 796
    rheumatism, I. 270
    yellow atrophy of the liver, II. 657
  in alcoholic neuritis, II. 1135
  in alcoholism, I. 495, 497, 500
  in amœbic dysentery, III. 430
  in amenorrhœa, IV. 727
  in arthritis deformans, I. 395
  in ascariasis, III. 494
  in ascites, II. 627
  in atony of the stomach, II. 290
  in bilharzia disease, III. 499
  in blackwater fever, III. 388
  in broncho-pneumonia, I. 1068
  in cancer, I. 148
    of the stomach, II. 298, 299
  in cardiac ascites, II. 631
    diseases, I. 1211-1227, 1243
  in catarrhal jaundice, II. 673, 674
  in chancre of the tongue, II. 134
  in chorea, II. 1257
  in chronic dilatation of the stomach, II. 314
    diarrhœa in adults, II. 482
    dysentery, III. 435

Drugs, in chronic (*contd.*)—
    gastritis, II. 351
    interstitial nephritis, II. 792
    laryngitis, III. 836
    simple ulcer of the stomach, II. 328
  in colic, I. 512
  in conjunctival diseases, III. 548
  in constipation in adults, II. 444
    in children, II. 436
  in cystitis, IV. 274, 275
  in diabetes insipidus, I. 429
  in diarrhœal diseases in children, II. 472, 475
  in disseminated sclerosis, II. 1073
  in dysmenorrhœa, IV. 745
  in eczema, III. 1032
  in epilepsy, II. 997
  in exophthalmic goître, II. 55
  in food fever, II. 239
  in gastric atony, II. 290
  in gastric neurasthenia, II. 356
  in gastroptosis, II. 321
  in goître, II. 62
  in gonorrhœal arthritis, I. 783
  in hæmorrhagic tendency of portal cirrhosis of the liver, II. 663
  in hæmorrhoids, II. 616
  in headache, I. 514
  in hill diarrhœa, III. 438
  in hypersecretion of the stomach, II. 367
  in hypertrophic biliary cirrhosis, II. 664
  in hysteria, II. 1012
  in impotence, II. 912
  in infantile hypertrophic stenosis of the pylorus, II. 339
  in inflammation of the stomach, II. 346
  in insanity of lactation, IV. 279
  in insomnia, II. 988
  in jaundice, II. 671
  in Kala Azar, III. 391
  in laryngeal spasm in children, III. 828
  in laryngitis stridulosa, III. 829
  in leprosy, III. 449, 450
  in malaria, III. 392
  in mania, II. 1287, 1288
  in marasmus, I. 466
  in meningitis, I. 253
  in menorrhagia, IV. 754
  in metrorrhagia, IV. 754
  in migraine, II. 1029
  in morphinism, I. 519
  in myelitis, II. 1215
  in obesity, I. 470
  in Oriental sore, III. 455
  in osteo-arthritis, I. 401
  in oxyuriasis, III. 495
  in paralysis agitans, II. 1270
  in pellagra, I. 522
  in pernicious anæmia, II. 3
  in ponos, III. 440
  in portal cirrhosis of the liver, II. 660
  in pruritus ani, II. 595

Drugs (*contd.*)—
  in pruritus of the vulva, IV. 517
  in puerperal sepsis, IV. 313
  in pulmonary embolism, IV. 325
  in pyelonephritis, infective, II. 808
  in rheumatism in childhood, I. 278
    (chronic) I. 490
    (muscular) I. 493
  in rhinorrhœa, III. 689
  in rickets, I. 479
  in salivary diseases, II. 130
  in secretory disorders of the stomach, II. 363
  in simple acute rhinitis, III. 701
    parotitis, II. 157
  in splenomegaly, II. 82
  in sprue, III. 444
  in sympathetic ophthalmitis, III. 600
  in syphilitic cirrhosis of the liver, II. 665
  in syphilis, I. 317, 319, 324
  in tabes dorsalis, II. 1088
  in tetanus in puerperium, IV., 327
  in tinnitis, III. 972
  in trachoma, III. 557
  in trichiniasis, III. 526
  in trichocephaliasis, III. 496
  in trigeminal neuralgia, II. 1116
  in tuberculous peritonitis, II. 645
  in tumours of the spinal cord, II. 1222
  in typhoid fever, I. 351
  in ulcer of the stomach, II. 378
  in uræmia, II. 837
  in urethritis in the puerperium, IV. 329
  in uterine fibroids, IV. 634
    inertia, IV. 253
  in vasomotor neuroses, II. 1242
  in vomiting, I. 512
  in whooping cough, I. 380
  in yellow fever, III. 412
  for albuminuria during pregnancy, IV. 31
  for chilblains, III. 1019
  for paralytic distension after abdominal operations, II. 271
  for stone in the ureter, II. 846-851
Dubois' apparatus for anæsthetics, III. 14
  method of hypnotism, III. 166
Dubreul's method of disarticulation at wrist joint, I. 815
Dunbar's pollantin antitoxic serum, III. 286-287
Duodenum, ulcer of, II. 375-381
  diet in, II. 211
  surgical treatment, II. 391-394
  with perforation, II. 396-398
Dupuytren's contraction, I. 942
  exercises in, I. 490
  enterotome, II. 489
  fracture, I. 629
  splint, I. 630
Dura mater, incision of in compression I. 883-885
Durham's tracheotomy tubes, use of, I. 196

Dust and pulmonary tuberculosis, I. 1118
  carrier of typhoid, I. 336
  inhalation of, causing pneumokoniosis, I. 1115
Dusting powders for intertrigo, IV. 529
  for vulvitis, IV. 529
Dyschezia, electricity in, II. 464
  enemata in, II. 457
  with weak abdominal muscles, electricity in, II. 465
Dysentery, acute, III. 428-432
  general treatment of, III. 428
  medicinal treatment of, III. 429
  serum treatment of, III. 430
  amœbic, III. 430
    calomel in, III. 432
    diet in, III. 430
    general treatment of, III. 430
    medicinal treatment of, III. 430
    other treatments of, III. 431
    prophylaxis of, III. 432
  bacillary, III. 428
  chronic, III. 433-436
    serum treatment of, III. 279
    vaccine treatment of, III. 279, 280
Dysmenorrhœa, IV. 736-750
  drugs in, IV. 745
  in puberty, IV. 501
  membranous, IV. 738
    palliative treatment, IV. 742
  prophylaxis of, IV. 742
  spasmodic, sterility in, IV. 847
  surgical treatment, IV. 746
Dyspareunia, IV. 839-842
  caruncle of urethra in, IV. 841
  in diseases of the fallopian tubes, IV. 841
  in diseases of uterus, IV. 844
Dyspepsia, acute, or acute gastric catarrh, I. 506-507
  and tropical liver, II. 678
  appendix, II. 409
  atonic, of stomach, II. 286
  complicating artificial pneumothorax, I. 1170
  diet in, II. 208
  forms of, I. 388
  gouty, and acidity, I. 442
  in acne vulgaris, III. 988
  in the menopause, IV. 501
  infantile, causes of, I. 54
  mineral waters and baths in, III. 139
  nervous, II. 354
Dysphonia spastica, III. 841
Dyspnœa and anæsthetics, III. 23
  complicating acute endocarditis, I. 1193
  in emphysema, I. 1087
  in goitre, II. 67
  in pulmonary tuberculosis, I. 1138
Dystrophy, muscular, II. 1250-1251

Ear, application of vibration to, III. 215
  cough in pulmonary tuberculosis, I. 1145
Ear (*contd.*)—
  diseases of, III. 876-889
    brain abscess in, III. 939-941
    complicating typhoid fever, I. 363
    intracranial complications in, III. 937-943
    intra-venous complications in, III. 937-943
    meningitis in, III. 937-939
    thrombosis of the sigmoid sinus in, III. 941-943
    See also Otitis Media.
  external, burns of, III. 888
    diseases of, III. 876-889
    foreign bodies in, III. 889-890
    frost-bite of, III. 888
    hæmatoma of, III. 888
    malformations of, III. 876
    wounds of, III. 887-888
  fistulæ of, III. 877
  internal, syphilis of, III. 978
  middle, diseases of, non-suppurative and Eustachian obstruction, III. 944-953
      patency of Eustachian tubes in, III. 947-951
    dry catarrh of, in Eustachian tube, III. 944
    inflammation of, acute, III. 894-903
      before perforation of tympanic membrane, III. 894
      in diphtheria, III. 902
      in enteric fever, III. 902
      in measles, III. 902
      in scarlet fever, III. 902
      local treatment, III. 894
      paracentesis in, III. 895
      perforation of tympanic membrane in, III. 896
      secondary to infectious diseases, III. 902
      suppuration of antrum in, III. 897
        of mastoid cells in, III. 897
    chronic, atticotomy in, III. 917
      aural polypi and, III. 909
      cauterisation in, III. 908
      epitympanic suppuration, III. 912
      granulations in, III. 908
      ossiculectomy in, III. 913
      removal of incus in, III. 915
        of malleus in, III. 914
        of malleus, incus and outer attic wall in, III. 913
        of stapes in, III. 916
      suppurative, III. 904-918
    complicating influenza, I. 239
  polypi of, III. 909
    after-treatment of, III. 911
  suppuration of, paroxysmal, vertigo of labyrinth and, III. 960-961
  telephone, III. 880
  tuberculosis of, III. 935-936
Ears, care of, in infants and children, I. 48
  examination of, in epilepsy, II. 991
  projecting, III. 878

- **Eaux-Bonnes** spa, III. 150
- **Eaux-Chaudes** spa, III. 150
- **Eberth** coli bacilli in typhoid fever, I. 345
- **Ecchymoses** of the tympanic membrane, III. 891
- **Echinococcus** disease, alveolar, III. 523
- **Echolalia** in psychasthenia, II. 1045
- **Eclampsia**, Bossi's metallic dilator in, IV. 39
  - Cæsarean section in, IV. 384
    - abdominal, IV. 40
  - chloroform in, IV. 36
  - cold baths in, IV. 37
  - decapsulation of kidneys in, IV. 37
  - forceps in, IV. 421
  - in pregnancy, IV. 34-41
  - incision of cervix in, IV. 40
  - lumbar puncture in, IV. 38
  - massage of the heart in, IV. 37
  - morphia in, IV. 36
  - nitro-glycerine in, IV. 37
  - obstetrical treatment of, IV. 38
  - oxygen in, IV. 37
  - pilocarpine in, IV. 37
  - rectal injection of glucose in, IV. 37
  - saline infusion, intravenous in, IV. 35
    - subcutaneous in, IV. 35
  - thyroid extract in, IV. 37
  - venesection in, IV. 36
  - veratrum viride in, IV. 37
- **Ectopia** of the testis, II. 904
  - vesicæ, II. 866-867
    - diversion of the urinary stream in, II. 866
    - plastic closure of bladder in, II. 866
- **Ectropion** of the eyelids, III. 581
- **Eczema**, III. 1032-1036
  - chronic, X-rays in, III. 351
  - complicating diabetes mellitus, I. 425
  - diet in, III. 1032
  - in gout and gouty conditions, I. 445
  - infantile, III. 1035
  - local treatment of, III. 1033
  - medicines for, III. 1032
  - occupations causing, I. 117
  - of the auricle, III. 880
  - of the meatus, III. 886
  - of the nails, III. 1082
  - vulva, ointments for, IV. 530
- **Edmunds** on auricular fibrillation, I. 1232
- **Effervescent** baths, III. 131
- **Effleurage** in massage, III. 203
- **Effusion**, aspiration in, 755
- **Egg** diet in gastric ulcer, II. 210
  - wine preparation of, I. 43
- **Eggs**, chemical composition of, II. 194, 206
  - children's dietary to include, I. 59
- **Egypt** as a winter resort, I. 461
- **Erhlich's** "606" in syphilitic affections of the vulva, IV. 521
  - specific for syphilis, I. 322
- **Eicken (Carl von)**, foreign bodies in the air-passages, with a description of bronchoscopy, III. 803-821
- **Einhorn's** spray apparatus in chronic gastritis, II. 349
- **Elastic** constriction, passive hyperæmia induced by, III. 46
  - œsophageal bougie, II. 172
    - conical-ended black, II. 172
- **Elbow**, congenital dislocation of, I. 936
  - dislocations of, I. 721
  - posterior moulded splint for, I. 600
  - tuberculous disease of, I. 777-779
- **Elbow-joint**, disarticulation at, I. 820-824
    - by anterior elliptical incision, I. 820
    - by a circular incision, I. 823
    - by a racket incision, I. 821-823
  - fracture of, I. 596
- **Electric** baths, III. 104
    - in joint affections, I. 747
  - conjunctivitis, III. 560
  - light, exposure to, I. 548
    - in gout and gouty conditions, I. 439
  - methods in cancer, I. 153
  - shock, I. 547
- **Electricity** in acute anterior polio-myelitis, II. 1056
  - in arthritis deformans, I. 398
  - in atony of the stomach, II. 288
  - in cancer, I. 153
  - in constipation in adults, II. 464
  - in craft palsies, II. 1268
  - in diabetes insipidus, I. 428
  - in disseminated sclerosis, II. 1074
  - in dyschezia, II. 464
    - with weak abdominal muscles, II. 465
  - in facial paralysis, II. 1094
  - in gastric neurasthenia, II. 354
  - in intestinal constipation, II. 464
  - in melancholia, II. 1294
  - in menorrhagia, IV. 762
  - in metrorrhagia, IV. 762
  - in neurasthenic constipation, II. 465
  - in paralysis of lead poisoning, I. 513
  - in paraplegia, II. 1198
  - in pruritus, III. 1101, 1104
  - in rheumatism (chronic), I. 488
  - in sterility, IV. 857
  - in tabes dorsalis, II. 1091
  - injuries and burns from, I. 547-549
  - local in electrotherapeutics, III. 106
- **Electro-therapeutics**, III. 103-110
  - in chronic synovitis and arthritis, I. 448, 746-748
  - in digestive disorders, III. 110
  - in disorders of circulatory system, III. 109
  - in nervous disorders, III. 108-109
  - in skin diseases, III. 110
  - localised electrisation in, III. 106
  - statical treatment in, III. 106
- **Electrolysis** in adenoma sebaceum, III. 991
  - in hypertrichosis, III. 1048
  - in small capillary nævi, III. 1079
  - of the Eustachian tube, III. 950

Elephantiasis arabum of the vulva, IV. 511
  of leg, III. 516
    palliative treatment of, III. 516
    radical treatment of, III. 516
  of vulva, III. 515 ; IV. 511
  scroti, III. 504-516
    bandage for after operation, III. 515
    cardinal rules in, III. 504
    flaps to penis in operation for, III. 511
    operating without the cord in, III. 513
    operation for, III. 504
      dressing in, III. 513
      flaps in, III. 509
    penis dressing in, III. 513
    perineal dressings in operation for, III. 513
    pubic dressings in operation for, III. 513
    sutures in operation for, III. 513
  X-rays in, III. 353
Elliotson (J. M.) and practice of mesmerism, III. 159
Elster spa, III. 150
Embolism, air, complicating labour, IV. 161-162
  by bacillary plugs, I. 1306
  by fibrinous particles, I. 1306
  by parenchymatous cells, I. 1306
  by tumour-cells, I. 1306
  cerebral, II. 1167
  excluding cerebral embolism, I. 1306-1308
  fat, I. 1306
  gangrene due to sudden obliteration of arteries by, I. 215
  of arteria centralis retina, III. 644
  of the kidneys, I. 1308
  of the mesenteric arteries, I. 1307
  of the spleen, I. 1307
  pulmonary, I. 1307
    after abdominal operations, II. 275
    complicating gynæcological surgery, IV. 494
      the puerperium, IV. 324-325
    prevention of, IV. 324
Emetics in chlorosis, II. 28
  in poisoning, I. 529
Emphysema, acute vesicular, I. 1088
  atrophic, I. 1088
  compensatory, I. 1088
  hypertrophic, palliative treatment of, I. 1084
    preventive treatment of, I. 1082
  interstitial, I. 1089
  physical exercises in, III. 251
  varieties of, I. 1082-1089
Empirical remedies for cancer, I. 147
Empiricism, reasons for, I. 1
Empyæma, I. 1099-1100
  anæsthetics in operations for, III. 30
  complicating pulmonary tuberculosis, I. 1158
Empyæma (*contd.*)—
  double, I. 1106
  failure to heal of an, I. 1106
  fistulous tracks in, injections in, I. 1110
  following injury of the chest, I. 1027
  generalised, after-treatment of, I. 1104
    drainage in, I. 1104
    in the lower part of the thorax, I. 1101
    operation for, I. 1103
  localised, I. 1106
  of the gall bladder, II. 710
  ruptured into a bronchus, I. 1106
  simple, of gall bladder, II. 702
  treatment of, I. 90
  tuberculous, I. 1108
  want of expansion of lung in, I. 1107
Ems spa, III. 150
Encephalocele of fœtus complicating labour, IV. 180
  of newborn child, IV. 357
Encephalopathy, saturnine, in lead poisoning, I. 514
Endocarditis, acute, I. 1190-1193
    after-care of, I. 1192
    complications of, I. 1193
    medicinal measures in, I. 1191
  in acute rheumatism, I. 272-274
  infective, malignant or ulcerative,
    bactericidal sera in, I. 20
    bacterial vaccines in, I. 206
    drugs in, I. 204
    non-specific measures in, I. 203-207
    prophylaxis of, I. 202
    sero-vaccines in, I. 206
    specific measures in, I. 204, 207
    synopsis of treatment of a case, I. 207
Endomastoiditis, purulent, III. 920
  suppurative, chronic indications for operation in, III. 922
Endometritis, IV. 620-631
  acute, IV. 620
    curettage in, IV. 621
    irrigation in, IV. 620
    leucorrhœa in, IV. 568
  amputation of vaginal portion of cervix in, IV. 630
  cervical, IV. 627
    vaccine treatment in, IV. 630
  chronic, IV. 622
    curettage in, IV. 622
    leucorrhœa in, IV. 569
  corporeal, vaccine treatment in, IV. 630
  gonorrhœal, leucorrhœa in, IV. 569
  importance of general treatment, IV. 630
  Schroeder's operation in, IV. 629, 630
  senile, leucorrhœa in, IV. 570
  sterility in, IV. 845
Endothelioma of the prostate, II. 932
  operability of, I. 122
Endotoxins in serum therapy, III. 259
Enemata as solvents in constipation in adults, II. 456
  before abdominal operations, II. 261
  chemical stimulation of, II. 452

- **Enemata** (*contd.*)—
  - general indications for, in constipation in adults, II. 457
  - high, in constipation in adults, II. 454
  - in children, II. 436, 437
  - in chronic dysentery, III. 433
  - in constipation in adults, II. 452
  - in dyschezia, II. 457
  - in removal of impacted fæces, II. 459
  - low, in constipation in adults, II. 455
  - mechanical stimulation of, II. 452
  - methods of giving, I. 31
  - of cold water in typhoid fever, I. 355
  - rectal, in constipation in adults, II. 454
  - thermal stimulation of, II. 452
  - varieties of, in constipation in adults, II. 454
  - various, I. 32
- **Engine-driver's** eczema, I. 117
- **English (T. Crisp)**, affections of the nipples, II. 977-978
  - appendicitis, II. 401-425
  - diseases and affections of the breast, II. 952-981
  - operative diagnosis of doubtful tumours of breast, II. 979-980
  - the preparation of patients for abdominal operations, II. 257-261
  - the treatment of patients after abdominal operations, II. 262-276
  - tuberculosis of the breast, II. 981
- **Enteric.** *See* Typhoid Fever.
- **Enteritis**, acute, in adults, II. 479-480
  - chronic, in adults, II. 480-482
  - infective, in newborn child, IV. 367
- **Enteroclysis** in hæmorrhage, I. 1268
- **Enteroptosis**, general treatment of, I. 430
  - (Glenard's disease), I. 430
    - surgical treatment of, I. 431
  - mechanical support in, I. 430
- **Enterotome**, Dupuytren's, II. 489
  - with key, Groves', II. 489
- **Enterotribe**, Gray's, I. 1258
- **Entropion** of the eyelids, III. 580
- **Enuresis**, nocturnal, II. 75-77
  - belladonna in, II. 75
  - minute supervision in, II. 75
  - peripheral irritation and, II. 75
  - thyroid extract in, II. 76
- **Epidemic** dropsy, III. 416
  - gangrenous proctitis, III. 437
- **Epidermolysis** bullosa, III. 1036
- **Epididymitis**, II. 906
  - complicating adenoma of the prostate, II. 945
    - gonorrhœa, I. 227
  - tubercular, complicating pulmonary tuberculosis, I. 1157
- **Epiglottis** punch, Lake-Barwell's, III. 875
- **Epilation** in hypertrichosis, III. 1048
- **Epilepsy**, II. 990-1007
  - acute exhaustion after fit in, II. 1005
- **Epilepsy** (*contd.*)—
  - alcoholic, I. 499; II. 993
  - and anæsthetics, III. 25
  - arrest of fit in, II. 1003
  - associated conditions in, II. 991
  - automatism in, II. 1005
  - belladonna in, II. 998
  - bromides in, II. 993
  - coma in, II. 983
  - combinations of bromides and other remedies in, II. 996
  - complications of, II. 1002
  - confirmed, II. 1006
  - diet in, II. 999
  - drugs in, II. 997
  - duration of treatment of, II. 998
  - examination of ears in, II. 991
  - eyes in, examination of, II. 991
  - features of, unfavourable for treatment, II. 1006, 1007
  - genital organs, examination in, II. 992.
  - hygienic treatment of, II. 1001
  - idiopathic, II. 990
  - introspection in, II. 990
  - mania, acute, in, II. 1005
  - marriage in, II. 1002
  - mental aspects of, II. 1310-1312
  - miscellaneous methods of treatment of, II. 999
  - new preparations of bromine in, II. 997
  - nose examination in, II. 991
  - of infective origin, II. 992
  - of recent origin, II. 993
  - of toxic origin, II. 993
  - opium in, II. 998
  - organotherapy in, II. 999
  - perversion of functions of alimentary tract in, II. 1018
    - viscera in, II. 1018
  - prodromata in, II. 1002
  - purin-free diet in, II. 1000
  - reflex, II. 991
  - seizure of fit in, II. 1003
  - self-abuse in, II. 992
  - serotherapy in, II. 999
  - solanum carolineuse in, II. 998
  - stomach examination in, II. 992
  - strychnine in, II. 998
  - surgical treatment of, II. 1007
  - teeth examination in, II. 992
  - tobacco intoxication in, II. 993
  - zinc salts in, II. 998
- **Epileptiform** convulsions in electric shock, I. 848
- **Epiphora** in fractures of the jaws, II. 100
- **Epiphysial** line of knee-joint, primary disease at, I. 768
- **Epiphysis**, separation of, in fractures, I. 590, 599
  - in newborn child, IV. 366
- **Epiphysitis**, acute, I. 698
- **Episiotomy** in second stage of labour, IV. 115

- **Epispadias** in congenital malformations of the penis, II. 875
- **Epistaxis**, III. 664-666
  - complicating typhoid fever, I. 357
  - due to constitutional conditions, III. 664
    - severe organic nasal disease, III. 665
  - immediate arrest of, III. 666
  - in chronic Bright's disease, I. 15
  - permanent arrest of, III. 666
  - relief from high blood-pressure by, I. 10
- **Epithelial** odontomes of the jaws, II. 112
- **Epithelioma**, embryonic, radium treatment of, III. 309
  - in X-rays, III. 348
  - of the lip, II. 97
  - of the scalp, I. 892
  - of the scrotum, II. 900
  - of the skin, III. 1037-1038
  - of the tongue, II. 138-144
  - of the vulva, IV. 515
  - primary, of the umbilicus, II. 281
- **Epitympanic** suppuration with perforation of membrana flaccida, III. 912
- **Epulis**, cause of, I. 113
  - myeloid, of jaw, II. 110
  - of the gums, III. 1193
- **Erasion** in lupus, III. 1149
  - in tuberculous disease of the knee-joint, I. 769, 770
- **Ergot**, acute poisoning by, I. 510, 533
  - dosage of in children's diseases, I. 68
  - gangrene, I. 219
  - in menorrhagia, IV. 754
  - in metrorrhagia, IV. 754
- **Ergotism**, I. 510, 533
- **Erichsen (Sir J. E.)** on shock from burns and scalds, I. 540
- **Ernst's** kidney truss, II. 787
- **Erysipelas**, I. 209-211
  - complicating pregnancy, IV. 49
    - typhoid fever, I. 357
  - constitutional treatment of, I. 211
  - ichthyol in, I. 210
  - iron perchloride in, I. 211
  - Kraske's method in, I. 210
  - lead lotion in, I. 210
  - local treatment of, I. 209
  - multiple incisions in, I. 210
  - of scalp, I. 888
  - of the auricle, III. 880
  - of the vulva, IV. 524
  - prophylaxis of, I. 209
  - vaccine therapy of, I. 211
- **Erythema** induration, III. 1151
  - multiforme, III. 1038
  - nodosum, I. 212-213
    - convalescent stage, I. 213
    - eruptive stage, I. 212
    - prodromal stage, I. 212
- **Erythrasma**, III. 475, 1039
- **Erythromelalgia**, II. 1230-1231
- **Escharotics** in Frambœsia tropica, III. 462
- **Esdaile (James)**, and mesmerism, III. 160
  - method of hypnotism, III. 163
- **Eserine** or physostigmine, poisoning by, I. 533
- **Esmarch's** bandage, I. 798
  - compression with, in hæmorrhage, I. 1259
- **Esophoria** of ocular muscles, III. 646
- **Essences**, food, preparation of, I. 42
- **Esthiomène** of the vulva, IV. 508
- **Estlander's** operation for empyema, I. 1107
- **Ether**, closed method of administration, III. 7
  - drop-bottle, III. 11
  - ethylic, as anæsthetic, III. 6
  - open method of administration, III. 9
  - preceded by ethyl chloride as anæsthetic, III. 11
    - nitrous oxide as anæsthetic, III. 11
  - semi-open method of administration, III. 11
- **Ethmoidal** sinus, III. 727-728
- **Ethyl** chloride, administration of, from small bag and face piece, III. 18
    - preceded by ether as anæsthetic, III. 11
  - ether as anæsthetic, III. 6
  - oxide as anæsthetic, III. 6
- **Eucaine** in sciatica, II. 1026
- **Eucalyptus** in ankylostomiasis, III. 491
  - in bronchitis, I. 245
  - oil, inunction of in scarlet fever, I. 288
- **Europeans**, physiological effect of tropical regions on, III. 375
- **Eustachian** bougies in patency of Eustachian tube, III. 949
  - catheter for patency of Eustachian tube, III. 948
  - tube, electrolysis of, III. 950
    - mucous membrane of, III. 951
    - obstruction of, and adenoid post-nasal growths, III. 947
      - and adhesions in naso-pharynx, III. 947
      - and chronic catarrhal otitis media, III. 944
        - hypertrophic rhinitis, III. 946
        - mucopurulent nasal catarrh, III. 946
        - naso-pharyngeal catarrh, III. 946
        - non-suppurative middle ear disease, III. 944-953
      - and dry catarrh of middle ear, III. 944
      - and naso-pharyngeal catarrh, III. 945
      - and oto-fibrosis, III. 944
      - and tumours of the naso-pharynx, III. 947
      - functional tests in, III. 944
      - general treatment, III. 945
      - nasal catarrh and, III. 945-947
      - prophylaxis, III. 945
    - patency of, and diseases of middle ear, III. 947-951

Evaux-les-Bains spa, III. 150
Eve's operation for gastroptosis, II. 323
Evian-les-Bains spa, III. 150
water in obesity, I. 470, 471
Evisceration of fœtus, IV. 416
anæsthetic in, IV. 416
difficulties in, IV. 416
operation for, steps of, IV. 416
Ewart's treatment in typhoid fever, I. 344
Excision, contra-indications to in tuberculous disease of the knee-joint, I. 770
in tuberculous disease of the knee-joint, I. 769
of joints in gunshot wounds, I. 562
of the knee-joint, deformity after, I. 771
Excitement in general paralysis of the insane, II. 1079
sleeplessness caused by, I. 54
Excretal diseases and their dissemination in the tropics, III. 383
Exercises, abdominal, in defective metabolism, III. 255
.after spinal injury, I. 908
after the administration of tuberculin, I. 1139
amount of food in, II. 199
and constipation in adults, II. 459
breathing, III. 227
during arthritis deformans, I. 392
excessive, a cause of strain, I. 8
for flat foot, I. 968
for infants and children, I. 51
for spinal curvature in children, I. 57
Fraenkel's, in tabes dorsalis, II. 1091
fundamental, III. 225
graduated, in pulmonary tuberculosis, I. 1159
in adhesions of the colon, II. 559
in arterio-sclerosis, I. 1291
in diabetes, I. 422
mellitus, I. 422
in diseases of the heart, I. 1208
in pregnancy, IV. 7
in pulmonary tuberculosis, I. 1123
in treatment of rheumatism (chronic), I. 489
of obesity, I. 469
influence of, in dietetics, II. 199
introductory, III. 224
muscular, physiological effect of, III. 206
physical, III. 222
arch-flexions in, III. 225
derivative, III. 226
double curves in for scoliosis, III. 247
for knock-knee, III. 235
for kyphosis, III. 236
for lordosis, III. 239
for scoliosis, III. 241
for spinal curvature, III. 236
for talipes, III. 233
for wry-neck, III. 233
four-footed, III. 248
in asthma, III. 251
in cardiac affections, III. 249
in chronic bronchitis, III. 251
Exercises, physical (*contd.*) —
in chronic nervous diseases, III. 256
in defective metabolism, III. 254
in emphysema, III, 251
in flat-foot, III. 234
in orthopædic cases, III. 233
in pulmonary affections, III. 249-254
movements to exercise muscles in scoliosis, III. 248
passive stretching movements in, for scoliosis, III. 247
remedial, III. 227
respiratory, necessary in young children. I. 50
stage in sanatorium treatment of pulmonary tuberculosis, I. 1129, 1135
Exertion in acute rheumatism, I. 273
Exhaustion, acute, after fit in epilepsy. II. 1005
and anæsthetics, III. 24
in sanatorium treatment of pulmonary tuberculosis, I. 1138
psychosis, II. 1299-1300
Exophoria of ocular muscles, III. 647
Exostoses of the meatus, III. 883
Exotoxins in serum therapy, III. 259
Expectoration, serous or albuminous in hydrothorax, I. 1092
Extension, method of, in tuberculous disease of the hip-joint, I. 753
External applications in diseases of children, I. 69
Extremities. *See* Limbs.
Eye, accommodation and refraction of, errors of, III. 528-542
spectacles for, III. 542
application of vibration to, III. 215
care of, in measles, I. 246
diseases of, III. 528-573
complicating small-pox, I. 309
functional, III. 543-546
examination of, in cataract, III. 617
in epilepsy, II. 991
excision of, anæsthetics for, III. 30
liquid pollantin serum for, III. 287
muscles of, diseases of, III. 646-655
powdered pollantin serum for, III. 287
spasm of accommodation in, III. 542
Eyeball, enucleation of, III. 658
mules, operation for, III. 660
gunshot wounds of, III. 657
injuries of, non-perforating, III. 656
operation for enucleation in, III. 658
perforating, III. 657
wounds of, III. 656-660
Eyelids, blepharitis of, III. 577
chalazia of, III. 578
diseases of, III. 577-582
ectropion of, III. 581
entropion of, III. 580
hordeola of, III. 579
ptosis of, III. 579
trichiasis of, III. 580
xanthelasma of, III. 582
Eyestrain, III. 534

Face, application of vibration to, III. 220
  deformity in fractures of jaw, II. 99
  dressings for, I. 88
  gunshot wounds of, I. 563
  hæmorrhage from, I. 1275
  hemiatrophy of, II. 1232
  operations on, and anæsthetics, III. 26
  palsy of, in newborn child, IV. 365
  paralysis of, II. 1093-1095
  presentation in labour, IV. 140-143
  spasm of, II. 1047
Facial nerve, injuries of, II. 1108
  neuralgia II. 1127 ; III. 170
Fæcal fistulæ, IV. 535
Fæces, analysis of, II. 190
  impacted, in constipation in adults, II. 452
    removal of by enemata, II. 459
  substances which increase the bulk of, in constipation in adults, II. 450
Fallopian tubes, actinomycosis of, IV. 800
  cancer of, IV. 801-803
  chorion-epithelioma of, IV. 804
  diseases of, IV. 799-819
  dyspareunia and, IV. 841
  hæmatosalpinx of, IV. 810
  hernia of, IV. 804
  hydrosalpinx of, IV. 824
  inflammation of, IV. 805-814
    salpingostomy in, IV. 825
    sterility in, IV. 845
  leucorrhœa from, IV. 571
  papilloma of, IV. 816
  removal of, sterility in, IV. 856
  salpingitis of, acute, IV. 810
    chronic, IV. 813
    complicating cancer of the uterus, IV. 814
  septic infection of, in salpingitis, IV. 807
  tuberculous diseases of, IV. 817-819
Familial diseases, II. 1244
Family amaurotic idiocy, II. 1244
Fango baths in arthritis deformans, I. 398
Farabœuf's method of amputation of the toes, I. 835
    through the leg, I. 855, 858
  subastragaloid disarticulation, I. 843
    comments on, I. 845
    incision in, I. 843
Faradism of kidneys in diabetes insipidus, I. 429
  use of, in sprains, I. 739
Farinaceous food for children, I. 59, 62
  in gout, I. 452
Fasciæ, affections of, II. 1321
Fat diet in diabetes, I. 419
  embolism, I. 1306
  food in rickets, I. 479
  foods arranged in order of value in, II. 197
  in dietary of children, I. 60
  milk modified by, II. 223
  processes in lipoma, I. 107
  value of, in dietetics, II. 201
Fatigue in children to be avoided, I. 56
  in migraine, II. 1027
Fats, digestion of, II. 191
  inunction of, I. 70
  not digestible during typhoid fever, I. 342
Fauces, ulceration of, in scarlet fever, I. 284
Favus, III. 1040
  of the nails, III. 1082
Feeble-mindedness, II. 1318—1320
Feeding after abdominal operations, II. 265
  after operation, directions for, I. 29
  artificial, of infants, I. 59
    methods of, I. 29, 33
  forced, when to avoid, I. 64
  improper, and diarrhœal diseases in children, II. 471
  of newborn child, frequency of, IV. 341
  subcutaneous, in shock, I. 103
  See also Diet, Food.
Feet, care of, in children, I. 57
    in infants and children, I. 46, 48
  protection of, in children, I. 50
Femoral artery, injuries of, I. 1276
  thrombo-phlebitis in puerperal sepsis, IV. 321
  thrombosis, complicating gynæcological surgery, IV. 494
Femur, Bryant's suspension apparatus, in fracture of, I. 616
  fractures of, I. 609-620
    condyle of, I. 619
    great trochanter of, I. 612
    in children, I. 577
    in newborn child, IV. 366
    neck of, I. 609, 611
    produced by direct violence, I. 670
    separation of, epiphyses in, I. 612, 620
    torsion or spiral, I. 664
    T-shaped or inter-condyloid, I. 619
  osteo-sarcoma of, I. 870
  rotation of, after reposition of the head, I. 946
Fenton's uterine dilator, IV. 478
  vulsellum, IV. 476
Fenwick (W. Soltau), atony of the stomach, II. 286-292
  atrophy of the stomach (achylea), II. 293-295
  cancer of the stomach, II. 296-301
  chronic dilatation of the stomach (pyloric stenosis), II. 312-315
  dilatation of the stomach, II. 310-311
  displacements of the stomach, II. 318-322
  hæmorrhage from the stomach, II. 325-330
  inflammation of the stomach, II. 353
  nervous diseases of the stomach, II. 354-358
  parasites and concretions of stomach, II. 359

- **Fenwick (W. Soltau)** (*contd.*)—
  - sea-sickness, II. 395
  - secretory disorders of the stomach, II. 360-369
  - symptoms of disordered digestion in the stomach, II. 370-374
  - ulcer of the stomach and duodenum, II. 375-381
- **Fermentation**, gastric, prevention of, II. 627
- **Ferments** in treatment of cancer, I. 151
- **Fetor** in cancer of cervix, IV. 617
- **Fever**, acute early, in puerperal sepsis, IV. 317
  - blackwater, III. 386-389
  - breast, in puerperal sepsis, IV. 315
  - continued, in puerperal sepsis, IV. 317
  - dengue, III. 390
  - early slight, in puerperal sepsis, IV. 314
  - enteric. *See* Typhoid.
  - food, II. 233-241
  - in measles, I. 244
  - intermittent hepatic, in cholelithiasis, II. 684
  - Japanese river, III. 390
  - malarial, III. 392-398
  - Malta, III. 399-400
  - Mediterranean, III. 399
  - non-septic, in puerperal sepsis, IV. 315
  - phlebotomus, III. 400
  - puerperal. *See* Puerperal Sepsis.
  - rheumatic. *See* Rheumatism.
  - "sand fly," III. 400
  - tropical, undefined, III. 410-411
  - undulant, III. 399
  - yellow, III. 412-413
- **Fevers**, acute, diet in, II. 202
  - subinvolution of uterus in, IV. 720
  - eruptive, cold sponging contraindicated, I. 160
  - general treatment of, I. 157-160
  - infections, management of convalescence, I. 65
  - relapsing, I. 266-267
  - tropical, III. 386-422, 410
- **Fibrinous** particles, embolism by, I. 1306
- **Fibro-adenomata** of the breast, II. 955
- **Fibrocystic** disease of the jaws, II. 112
- **Fibroids** of broad ligament, IV. 653
  - false, hysterectomy in, IV. 654
  - true, enucleation in, IV. 653
  - cervical anterior hysterectomy in, IV. 651
    - central hysterectomy in, IV. 648-649
    - complicating labour, IV. 159
    - hysterectomy in, IV. 649
    - posterior, hysterectomy for, IV. 652
  - Paget's recurrent, I. 114
  - pedunculated, abdominal myomectomy in, IV. 658
  - polypi, uterine, IV. 658-661
    - vaginal enucleation in, IV. 660
  - sessile, abdominal hysterectomy in, IV. 658
- **Fibroids** (*contd.*)—
  - uterine, IV. 634, 663
    - drugs in, IV. 634
    - hysterectomy in, IV. 639
      - abdominal, in, IV. 641
      - indications for, IV. 637
      - sub-total in, IV. 643
      - total, in, IV. 647
    - leucorrhœa in, IV. 570
    - myomectomy in, IV. 658-663
    - pain in, IV. 638
    - preliminary considerations, IV. 634
    - pressure symptoms in, IV. 638
    - removal of, IV. 635
    - should ovaries be removed in? IV. 639
    - vaginal hysterectomy in, IV. 655-658
- **Fibrolysin** in adhesions of the colon, II. 560
  - in cheloids, I. 113
  - in chronic rheumatism, I. 490
    - synovitis and arthritis, I. 748
  - in disseminated sclerosis, II. 1074
  - in tabes dorsalis, II. 1086
- **Fibroma** of the female urethra, IV. 572
  - of the gums, III. 1193
  - of the prostate, II. 950-951
- **Fibromata** mollusca, characteristics of, I. 112
  - of muscle, II. 1325
  - of the auricle, III. 879
  - of the jaw, II. 109
  - pharyngeal, I. 113
  - simple, of the scalp, I. 893
  - situation of, I. 111
  - subcutaneous, I. 111
  - varieties of, I. 112
- **Fibrosis**, arterio-capillary, I. 1288
- **Fibrositis**, I. 483
  - rheumatic, II. 1121
- **Fibrous** ankylosis of the jaws, II. 106
  - epalis of the jaw, II. 109
- **Fibula**, congenital defects of, I. 950
  - fracture of, I. 622-632
    - involving the ankle-joint, I. 628
  - Pott's fracture of, I. 629
  - torsion or spiral fracture of, I. 657
- **Filaria** lymphangiectasis, III. 516
  - medinensis in the tropics, III. 384
    - infection by, III. 501
  - volvulus in chappa, III. 466
- **Filariasis**, III. 503
  - chyluria in, III. 503
  - complicating pregnancy, IV. 57
  - hydrocele in, III. 516
  - lymph scrotum in, III. 503
  - lymphangitis in, III. 503
  - orchitis in, III. 503
- **Fingers**, amputations of, I. 804-813
    - sites for, I. 804
    - steps for, I. 808-810
  - congenital contraction of, I. 938
    - dislocation of, I. 938
  - contractures of, I. 941

Fingers (*contd.*)—
  disarticulation of, by racket incision, I. 806
  dropped, II. 1329
  infective abscess of, I. 169
  paralysis of, in lead poisoning, I. 513
  supernumerary, in new-born, IV. 363
  surgery of, I. 170-171
Finney's operation for pyloric stenosis, II. 316
Finsen, red light treatment of small-pox, I. 307
  light in lupus, III. 1147
    in lupus erythematosus, III. 1071
    in rodent ulcer, III. 1134
Fires in sick room, I. 26
  open, in nurseries, I. 44
Fish, chemical composition of, II. 193
  in dietary of children, I. 60, 61
  inspection of, in the tropics, III. 385
Fissure, anal, II. 597
Fistula and sinus, general and local treatment of, I. 299-301
Fistulæ, aërial, of neck, II. 166
  anal, II. 606-610
  aural, III. 877
  between bladder and intestine, II. 491
    intestine and female generative organs, II. 491
  biliary, II. 698, 699
    gastric, II. 699
  branchial, of neck, II. 166
  cervical, II. 166-167
  complicating operation for goître, II. 69
  fæcal, IV. 535
  gastro-colic, II. 490
  intervisceral, and cholelithiasis, II. 695
  intestinal, II. 483-492
  median cervical, II. 167
  mucous, of the gall-bladder, II. 698
  pathological surface, II. 699
  peri-renal, II. 767-769
  peritoneal, II. 280
  recti-urethral, and acute prostatitis, II. 923
  renal, II. 767-769
    treatment of, II. 768
  resulting from infective processes of uterus, IV. 668
  salivary, and inflammation of parotid gland, II. 160
  supra-pubic, failure of closure of, complicating adenoma of prostate, II. 945
  thyro-glossal, of neck, II. 167
  thyroid, II. 167
  tracheal, III. 799
  umbilical, acquired, II. 281
  ureteral, II. 842-845 ; IV. 667
  uretero-vaginal, IV. 534
  urinary, IV. 535
    at the umbilicus, in adults, II. 279
      in infants, II. 278
  uterine, IV. 664-668
    from malignant growths, IV. 668
Fistulæ (*contd.*)—
  utero-intestinal, IV. 667
  utero-vesical, IV. 666
  vaginal, IV. 533-536
  vesico-cervical, IV. 737
  vesico-vaginal, IV. 533 ; IV. 878-881
    operation for, IV. 736
  vitello-intestinal, II. 278
Fits in tumours of the brain, II. 1202
Flannel underclothing for children, I. 50
Flaps, amputation, I. 791, 800
  vitality of, in amputations, I. 791
Flat-foot, I. 967
  exercises for, I. 968
  inflammatory, I. 969
  in rickets, I. 482
  physical exercises in, III. 234
  traumatic, I. 970
Flatulence, after abdominal operations, II. 264
  from foods containing curds, II. 231
  in disordered digestion of the stomach, II. 371
Flexner's anti-meningitis serum, clinical results of, III. 276
    in meningococcus infection, III. 275
  serum in meningitis, I. 254
Flies, carriers of typhoid fever, I. 336
Flour, starch-free, I. 421
Flours, chemical composition of, II. 195
Floury foods in infant feeding, II. 229
Fluid diet in infectious diseases, I. 158
  food necessary for young children, I. 53
Flushing curette, IV. 621
Fœtor oris, II. 127
Fœtus, amencephalus of, complicating labour, IV. 180
  body of, extraction of in craniotomy, IV. 411
  chondrodystrophia of, II. 1227
  condition of, forceps in, IV. 425
  congenital septic disease of kidney in, complicating labour, IV. 180
    goître of, complicating labour, IV. 180
  ceptic hygroma of, complicating labour, IV. 180
  death of, IV. 14
    induction of premature labour in, IV. 436
  decapitation of, 413-415
  deformities of, causing obstruction to labour, IV. 176-181
  diseases of, causing obstruction to labour, IV. 176-181
  distress of, forceps in, IV. 421
  encephalocele of, complicating labour IV. 180
  enlargement of, complicating labour, IV. 179-181
    general, complicating labour, IV. 176
  evisceration of, IV. 416
    in impacted shoulder presentation, IV. 416
  extraction of, in craniotomy, IV. 406

Fœtus (*contd.*)—
  forceps to hasten delivery in interests of, IV. 421
  head of, position of blades of forceps to, IV. 431
  hydrocephalus of, complicating labour, IV. 179
  indications of, for induction of premature labour, IV. 434
  large, induction of premature labour and, IV. 436
  malposition of, forceps in, IV. 421
  measures for resuscitating, in forceps, IV. 425
  monstrosities of, complicating labour, IV. 180
  presentations of, forceps in, IV. 421-422
  syphilis of, complicating pregnancy, IV. 77
  urethra of, imperforate, complicating labour, IV. 180
Föhn wind of Switzerland, III. 75
Folliclis, III. 1151
Fomentations, anodyne, in acute rheumatism, I. 269
  in chronic rheumatism, I. 486
  and stupes, I. 35
Food, administration of, in aphthous stomatitis, II. 121
  amount and character of, bodily health and, I. 451
  amount required in different circumstances, II. 199
  animal, in gout, I. 451
  articles to be avoided by gouty, I. 455
  canned, chemical composition of, II. 192
  carrier of typhoid, I. 337
  daily quantity of, for children, I. 63
  digestibility of, in gout, I. 448
  excess of, effect on digestive system, I. 8
  gastro-intestinal derangement due to, II. 232-241
  in the tropics, III. 378
  in typhoid fever, I. 341
  materials, chemical composition of, II. 192
  nitrogenous, causing gout, I. 448
  preserved, chemical composition of, II. 192
  purin-free, I. 452
  refusal of, in general paralysis of the insane, II. 1079
  requirements in muscular work, II. 200
  solid, forbidden before an operation, I. 27
  starchy, effect on young children, I. 58-61
  total value of, II. 199
  fever, II. 233-241
    drugs in, II. 239
  poisoning, I. 506-511
    bacterial or ptomaine, I. 507-510
    from tinned food, I. 510
Foods, analyses of, II. 192
  animal (Bunge), II. 745
  ash percentage in, II. 745
    caloric value of, II. 198
  common, arranged according to value in protein, carbohydrate and fat, II. 197
  composition of, II. 192
  containing no starch in infant feeding, II. 229
  floury, in infant feeding, II. 229
  oxalic acid in, II. 744
  prepared, in infant feeding, II. 227
  proportion of, in dietetics, II. 200
  tables of, showing percentage of carbohydrates, I. 411
  tinned, metallic poisoning from, I. 510
Foot, amputations of, I. 836-850
  dislocations of, I. 733
  everted, I. 967
  Farabœuf's subastragaloid disarticulation of, I. 844
  hollow or contracted, I. 963
  hot-air apparatus for, III. 325
  inversion exercise for flat foot, III. 235
  madura, III. 485
  suction glass for, in hyperæmic treatment, III. 59
  weak, I. 967
Foramen ovale, neuralgia in, II. 1119
  rotundum, alcohol injection into for neuralgia, II. 1020
    neuralgia in, II. 1118
Forceps, action of, IV. 431
  anæsthesia and, IV. 425
  Attie punch, III. 916
  axis-traction, IV. 429-431
  Bonney's dissecting, IV. 476, 477
  Brünings', III. 808
  capsule, for cataract, III. 626
  choice of, IV. 422
  condition of cervix and, IV. 424
    the child, and, IV. 425
    uterus and, IV. 424
  craniotomy, cranioclast used as, IV. 407
  dangers of delivery by, IV. 430
  dental, III. 1180-1187
  for delay in labour, IV. 418
  for grasping the tonsil, III. 753
  for oblique head, IV. 431
  for removal of foreign bodies in the gullet, II. 184
  Hartmann's, III. 908
  in abnormal obliquity of uterus, IV. 420
  in ante-partum hæmorrhage, IV. 420
  in brow presentation, IV. 422
  in craniotomy, IV. 411
  in delay of after-coming head, IV. 422, 430
  in eclampsia, IV. 421
  in exhaustion of mother, IV. 420
  in expression of the cord, IV. 421
  in fœtal distress, IV. 421

Forceps (*contd.*)—
  in heart disease during labour, IV. 420
  in locked twins, IV. 422
  in malposition of child, IV. 421
  in measures for resuscitating the child, IV. 425
  in mento-anterior presentation of face, IV. 421
  in occipito-posterior presentation, IV. 421
  in post-partum hæmorrhage, IV. 426
  in prolapse of child's arm, IV. 422
  in prolapse of the cord, IV. 421
  in rigidity of pelvic floor, IV. 420
  in threatened rupture of perinæum, IV. 420
  in transverse head, IV. 432
  Lake's laryngeal punch, III. 874
  Lane's tissue, I. 1256
  long curved, application of, IV. 426, 428
  Luc's nasal, III. 693
  Mackenzie's laryngeal, III. 847
  methods of applying, IV. 426-430
  œsophageal, II. 184-185
  Paterson's laryngeal, III. 848
  position of blades of, to fœtal head, IV. 431
  position of blades of, to maternal pelvis, IV. 431
  position of child and patient, IV. 424
  pressure, IV. 476
  relative advantages of, IV. 432
  ring, IV. 475, 476
  round ligament, IV. 481
  scissors, De Wecker's, III. 639
  Thomson Walker's, for calculus, II. 760
  to assist delivery in the interests of the mother, IV. 419-420
  toothed dissecting in lacerations of cervix, IV. 189
    in operations on tonsil, III. 752
  use of, in disproportion between child and maternal pelvis, IV. 417-419
    indications for, IV. 417
  uterine, with pledget of wool, IV. 625
  Walcher's position in, IV. 424
  Whistler's laryngeal, III. 848
Forearm, amputation through, I. 816-820
  circular amputation through, I. 819
  fractures of the bones of, I. 596-603
  modified circular amputation of, I. 816
  paralysis of extensor muscles of, electro-therapeutics in, III. 107
  suction glass for, in hyperæmic treatment, III. 58
  varix of, I. 1321
Foreign bodies in the air-passages, III. 803-821
    cocainisation in, III. 816
    general anæsthesia in, III. 813
    instruments for removal of, III. 806
    introduction of the bronchoscope, III. 816
    local anæsthesia in, III. 813
Foreign bodies (*contd.*)—
    position of patient in the direct method, III. 814
    technique of direct method for, III. 814, 818
  in the auricle, III. 888
  in the bronchus, abscess due to, I. 1061
  in the chest, I. 1027
  in the external ear, III. 888-889
  in the female bladder, IV. 875-876
  in the intestines, II. 493-497
  in the meatus, III. 888
  in the nose, III. 667
  in the œsophagus, II. 184-189
  in the stomach, II. 285
  in the urethra, II. 884
  in the vagina, IV. 537
  introduction of, in aneurysm, I. 1302
Forlanini's method of artificial pneumothorax, I. 1170
Formalin gas, fumigation by means of, I. 163
  spray, disinfection by, I. 120
Formamint tabloids in diphtheria, I. 194
Foruncles. *See* Furuncles.
Fothergill (W. E.), cysts of the vagina, IV. 531-532
  fistulæ of the vagina, IV. 533-536
  foreign bodies in the vagina, IV. 537
  infections of the vagina, IV. 538-539
  injuries of the vagina, IV. 540
  malformations of the vagina, IV. 541-544
  prolapse of the vagina, IV. 545-552
  tumours of the vagina, IV. 553-554
Foulerton on thymus extract in cancer, I. 150
Fournier (Prof.), on treatment of syphilis, I. 317
Fowler's position for administration of fluids per rectum in peritonitis, II. 635
  solution, dosage of in children's diseases, I. 68
Fox (R. Fortescue), hydrology, III. 111-147
  index of spas, III. 147-158
Fox (Wilfrid S.), adenoma sebaceum, III. 991
  blastomycetic dermatitis, III. 1005
  cheloid or acne cheloid, III. 1018
  chilblains, III. 1019-1020
  corns, III. 1024-1025
  Darier's disease, III. 1026
  epithelioma, III. 1037-1038
  erythrasma, III. 1039
  favus, III. 1040
  hydradenomata, or adenoma of the sweat glands, III. 1044
  icthyosis and xeroderma, III. 1053
  innocent tumours of the skin (myomata), III. 1057
  Kaposi's disease (xeroderma pigmentosum), III. 1057
  lentigo (freckles), III. 1058
  molluscum contagiosum, III. 1073
  molluscum fibrosum: von Recklinghausen's disease, III. 1074

Fox (Wilfrid S.) (*contd.*)—
  mycosis fungoides, III. 1076
  nævi moles, birth marks, III. 1077-1081
  pediculosis, III. 1086-1087
  pityriasis versicolor, III. 1095
  ringworm, III. 1125-1131
  rodent ulcer, III. 1132-1134
  rosacea. acne rosacea rhinophyma, III. 1135-1136
  scabies, III. 1137-1138
  sebaceous cysts, III. 1140
  seborrhœa, III. 1141-1142
  seborrhœic dermatitis, III. 1142
  tuberculides, III. 1146-1152
  urticaria angioneurotic œdema, lichen urticatis, urticaria pigmentosa, III. 1154-1156
  warts (verrucæ), III. 1157-1159
  xanthoma, III. 1160
  X-ray dermatitis, III. 1161-1163
Fracture-dislocations of the spine, I. 902-905
Fractures, I. 568-633
  accurate apposition of fragments in, I. 639
  badly united, operative treatment of, I. 650
  callus formation in, I. 579
  causes of displacement in, I. 570
  Collis', I. 578
  complications, &c., of, Zander treatment in, III. 374
  compound, general principles of treatment of, I. 581-583
  extension principle in, I. 577
  fragments in, apposition of, I. 642
  gangrene following, I. 582
  general principles of treatment of, I. 568-633
  greenstick, I. 570
  gunshot, I. 561
  immobolisation in, I. 572
  impacted, I. 570
  instruments used in the operative treatment of, I. 637-651
  local treatment of, I. 569
  massage and passive movements in, I. 577
  nerve injury in, II. 1101
  œdema in, I. 578
  of bone in extraction of teeth, III. 1188
  of the head in infants, I. 886
  of the larynx, III. 825
  of the long bones in newborn child, IV. 365
  of the teeth, III. 1177, 1188
  operative treatment of, I. 634-693
  painful action of tendons in, I. 578
  pelvic, I. 605
  pulley extension apparatus for, I. 576
  reduction of, I. 569, 571
  retentive apparatus, forms of, I. 573
  septic, I. 561
  septicæmia following, I. 581
  setting of, I. 571
Fractures (*contd.*)—
  splints for, various, I. 573-575
  spontaneous, in cancer, I. 146
  stiff joints following, massage in, III. 207
  suppuration following, I. 582
  water pillows for, I. 31
Fraenkel's exercises in tabes dorsalis, II. 1091
Fragilitas ossium, I. 712
Frambœsia tropica, III. 461
  constitutional treatment of, III. 462
  local treatment of, III. 462
  prophylaxis of, III. 461
Frank's operation for malignant stricture of the œsophagus, II. 177
Frankau (C. H. S.), affections of the tendon sheaths, II. 1330-1333
  cranial meningocele, II. 1194
  diseases and affections of bursæ, II. 1334-1335
  hernia cerebri, II. 1190
  inflammatory affections of muscles, II 1324-1325
  injuries of muscles, II. 1321-1323
  injuries of tendons, II. 1326-1329
  new growths of muscle, II. 1325
  surgical treatment of aneurysm, I. 1301-1305
  surgical treatment of epilepsy, II. 1007
  urethritis, chronic (gleet), II. 877-879
Franzenslad spa, III. 150
Fraser (J. S.), eustachian obstruction and chronic non-supurative middle ear disease, III. 944-953
  otosclerosis, III. 954-957
Freckles, lentigo, III. 1058
Freeland (J. R.), management of the newborn child, IV. 337-372
Freeman (John), on vaccine therapy of whooping cough, I. 383
Freezing, destruction of rodent ulcer by, I. 115
French (Herbert), Addison's pernicious anæmia, II. 1-12
  anæmia due to actual loss of blood, II. 18-19
  anæmia due to some definite malady II. 13-17
  aplastic anæmia, II. 37
  chlorosis, II. 20-31
  chorea, II. 1257-1263
  hæmophilia, II. 31-36
  mental diseases in pregnant women, IV 46-58
Friction and massage, II. 204
Friedreich's disease, II. 1248
Frontal sinus, III. 728-730
  inflammation of complicating influenza I. 239
  suppuration of, III. 729
Frost-bite of the external ear, III. 888
Fruit, digestion of, in young children, I 53, 62

ontd.)--
ious use of, in children, I. 53
ıt. I. 454
ue. III. 443
hoid fever, I. 344
hemical composition of, II. 196
ıyopathic ptosis, III. 650
rkers' eczema, I. 117
tion in cancer, I. 154
vix uteri, IV. 617
ions in asthma, I. 1039
ormalin gas, I. 163
ulphurous acid gas, I. 162
grip in palpation in normal labour,

uffle in normal labour, IV. 104
s or boils, III. 1006–1011

peration for cleft palate, II. 150
ul screw, in fractures of the jaw,
07
ele in the puerperium, IV. 336
breast, II. 953
s knife for symphysiotomy, IV.

lder, actinomycosis of, II. 711
ı of, chronic, II. 700
is of, hypertrophic, II. 664
us inflammation of, II. 702
s of, II. 680
ion of, II. 710
of, II. 710
na of, II. 710
of. II. 698
ne of, II. 704
ls of, II. 711
s of, II. 710
ophy of, II. 710
nation of, II. 699-709
wed by cancer, I. 119
of, II. 680
fistulæ of, II. 698
owths of, II. 711
tion of, II. 707
ı of, II. 712
empyema of, II. 702
e of, II. 706
s of. II. 710-712
scoop, II. 688
corset for movable kidney, II.

l in hæmorrhage, I. 1261
ı in gout, I. 439
us, I. 739
eys in diabetes insipidus, I. 429
autery in chronic infections of
nsil, III. 751
orrhage, I. 1258
mical composition of, II. 193
young children, I. 52
of tendon sheaths, II. 1332
I. 214-220
reading traumatic. I. 219
uries of arteries, I. 1279

Gangrene (*contd.*)—
amputation in, I. 216, 790
carbolic, I. 219
diabetic, I. 217, 426
due to ergot, I. 219
to gradual obliteration of the main arteries, I. 215
to mechanical obstruction of a main arterial trunk, I. 215
to sudden obliteration of the main arterial, I. 215
following carbolic fomentations, I. 168, 170
fractures, I. 582
from direct crushing, I. 214
general treatment of, I. 214
in arterio-sclerosis, I. 1296
in Raynaud's disease, II. 1240
moist, complicating diabetes mellitus, I. 426
of the gall bladder, II. 704
of the lung, I. 1090
senile, I. 215
symmetrical, I. 218
Gangrenes, specific, I. 219
Gangrenous proctitis, epidemic, III. 437
Gardiner (**F.**), cheiropompholyx, III. 1015-1016
chloasma, III. 1017
dermatitis artefacta, III. 1027
herpetiforms, III. 1028
(occupation), III. 1029-1030
diseases of the nails, III. 1082
drug eruptions, III. 1031
eczema, III. 1032-1036
epidermolysis bullosa, III. 1036
erythema multiforme, III. 1038
herpes febrils, III. 1042
zoster, III. 1043
melanoderma, III. 1073
milium, III. 1073
monilithrix, III. 1075
morphœa, III. 1075
pemphigus, III. 1088, 1089
pityriasis rubra, III. 1093
pilaris, III. 1092
prurigo, III. 1096
purpura, III. 1124
scleroderma, III. 1139
sycosis, III. 1144, 1145
trichorrhexis nodosa, III. 1145
tylosis, III. 1153
vitiligo, III. 1159
Garrod (**A. E.**), urinary disorder, II. 730-750
Gaseous poisons, treatment of, I. 534-535
Gasserian ganglion, excision of, for trigeminal neuralgia, II. 1117, 1128
injection of alcohol, II. 1119
Gastem spa, III. 150
Gastrectomy in gastric cancer, I. 140
partial, for cancer of the stomach, II. 308
for hour-glass stomach, II. 334, 336
statistics of, II. 303

Gastric juice, diminution of, II. 293
Gastritis, acute simple, II. 345, 348
    toxic, II. 348
  alcoholic, II. 353
  chronic, II. 294, 348
    general treatment of, II. 348
    medicinal treatment of, II. 351
  diet in, II. 345, 350
  general treatment in, II. 345
  medicinal treatment of, II. 346
  phlegmonous, II. 353
Gastro-enterostomy for hour-glass stomach, II. 334
  for hypertrophic pyloric stenosis, II. 342, 343
  for relief of obstruction in cancer of alimentary system, I. 140
  in ulcer of the stomach, II. 386
  statistics of, II. 302
Gastro-gastrostomy for hour-glass stomach, II. 334
Gastro-intestinal antiseptics in pernicious anæmia, II. 6
  derangements due to food, II. 233-241
  form of gout, I. 447
  post-operative hæmorrhage, I. 1276
  temperature in pulmonary tuberculosis, I. 1139
Gastro-jejunostomy for pyloric stenosis, II. 316
  in hæmatemesis, II. 333
Gastroliths, II. 359
Gastrolysis for hour-glass stomach, II. 334
  for pyloric stenosis, II. 316
  simple, II. 336
Gastroplasty for hour-glass stomach, II. 334
Gastroptosis, II. 319
  accompanied by myasthenia, II. 321
  belt for, II. 320
  diet in, II. 320
  medicinal treatment of, II. 321
  surgical treatment of, II. 323-324
Gastrostomy, feeding after, method of, I. 33
  for malignant stricture of the œsophagus, II. 176
  for relief of obstruction in cancer of alimentary system, I. 139
  mortality of, II. 305
Gastrotomy for foreign bodies in the œsophagus, II. 187
  in the stomach, II. 285
Gaurain's portable stand, with spinal board, I. 751
  method in abscesses, I. 757
Gauze, antiseptic, use of in operations, I. 85-86
  for surgical dressings, varieties of, I. 74-78
  plugging after abdominal operations, II. 267
  strips in drainage of acute abscess, I. 167, 170
Gelatine in hæmorrhage, I. 1262
  injection of, in hæmophilea, II. 34
  subcutaneous injections of, in aortic aneurysm, I. 1298
Genital organs, care of, in children, I. 48
  examination of, in epilepsy, IV. 992
  female, and intestine fistulæ between, II. 491
  obesity and, I. 473
  male, diseases of, II. 874
  passages, dilation of, in symphysiotomy, IV. 454
  tract, lacerations of, amputation of cervix in, IV. 194
    Clover's clutch in, IV. 188
      complicating labour, IV. 188-213
    non-hæmorrhagic discharges from, IV. 555-574
    re-sterilisation of, after probable infection in puerperal sepsis, IV. 290
    slower sterilisation of, in puerperal sepsis, IV. 289
Genito-urinary organs, physical defects of, I. 231
  passages, anæsthetics in operations on, III. 32
  symptoms in paraplegia, II. 1199
  system in typhoid fever, I. 361
Genu recurvatum, I. 949
  valgum, or knock-knee, I. 959
  varum and bow-leg, I. 962
Geographical pathology, III. 375-516
  tongue (annulus migrans), II. 126-129
Gibbons (R. A.), dysmenorrhœa, IV. 736-750
  dyspareunia, IV. 839-842
  sterility, IV. 843-859
  vaginismus, IV. 860-864
Gigli's saw in pubiotomy, IV. 447, 450
  wire saw in fractures of the jaws, II. 106
Gingivitis in syphilis, I. 318
  marginal, III. 1191
Glanders, III. 670
  acute, I. 222
  chronic, I. 222
  differential diagnosis, I. 221
  incubation period, I. 222
  parotid inflammation of, II. 157-163
Glands, adrenal, diseases of, II. 46-48
  axillary, removal of in malignant disease of the breast, II. 972
  carcinoma of, I. 1350
    of, metastatic growths, I. 124, 126
    caseating tuberculous, in mediastina, I. 1177
  enlarged, application of vibration in, III. 218
    cervical, complicating influenza, I. 239
  lymphatic, diseases of, I. 1339-1340
    diseases secondary to infective processes, I. 1339
    tuberculous disease of, I. 1344
  lymphosarcoma of, I. 1350

(contd.)—
growths of, I. 1350
ary, diseases of, II. 130-131, 157-163
uries of, II. 157-163
ngual, inflammation of, II. 158
axillary, inflammation of, II. 158
-clavicular, enlargement in malig-
nt disease of the breast, II. 964
culous, operative procedures for,
I. 1348
gical treatment of, I. 1348
lar affections in measles, I. 246
ma, III. 602-606
idiopathic, III. 602
nic, III. 604
mittent, III. 604
'**s** operation on the nasal septum,
681
I. 877-879
l's disease (enteroptosis), I. 430
ral treatment, I. 430
anical support in, I. 430
cal treatment of, I. 431
l cavity, fracture of, I. 585
a palpalis and sleeping sickness,
883
is, acute parenchymatous, II. 133
erate chronic, in syphilitic affec-
ns of the tongue, II. 136
œdema of, complicating cut throat,
55
sterilised rubber, use of, in labour,
. 288
f in operations, I. 81
, rectal injection of, in eclampsia,
. 37
ion in hæmorrhage, I. 1267
l arteries, injuries to, I. 1276
ne and belladonna in glandular
ections, I. 246
a, I. 32
ositories in constipation in adults,
453
ria in diabetes, diet in, I. 413-416
ut and gouty conditions, I. 446
ral waters and baths in, III. 140
milk, micrococcus melitensis in,
384
II. 62-71
cation of vibration in, III. 216
lications after the operation for,
II. 68
ring operation for, II. 68
c, congenital, complicating labour,
. 180
hthalmic, II. 54-57
er-treatment of, II. 60
mate in, II. 56; III. 99
nplicating pregnancy, IV. 57
t in, II. 55
gs in, II. 55
ebius's anti-thyroid serum in, II.
56
t in, II. 54
ults of surgical treatment of, II. 60

Goître, exophthalmic (*contd.*)—
    surgical treatment of, II. 57, 58-61
        X-rays in, III. 366
    general treatment of, II. 62
    indications for operation in, I. 67
    local treatment of, II. 63
    medicinal treatment of, II. 62
    operations for, details of, II. 65, 70
    operative treatment of, II. 63
    resection-enucleation for, II. 65
    results of operative treatment of, II. 70
Gonococcus in salpingitis, IV. 815
    infections, serum therapy of, III. 280-281
Gonorrhœa, I. 223-230
    abscesses complicating, I. 226
    acute, vaccine therapy of, III. 280
    chronic, vaccine therapy of, III. 281
    complications of, I. 225-230
    epididymitis in, I. 227
    injections in, I. 224
    Janet's method of urethral irrigation in, I. 224
    lymphangitis in, I. 226
    œdema of prepuce in, I. 225
    of cervix uteri, leucorrhœa in, IV. 566
    sterility due to, I. 227
    urethral irrigations in, I. 224
        complicating the puerperium, IV. 329
    urethritis in, I. 281
    vaccine therapy of, I. 225, III. 280
    zinc astringent solutions in, I. 224
Gonorrhœal arthritis, I. 781-783
        local treatment, I. 781
        serum therapy in, I. 783
        vaccine therapy in, I. 782, III. 281
    endometritis, leucorrhœa in, IV. 569
    ophthalmia, I. 228
        in the adult, III. 555
    peritonitis, II. 642
    rheumatism, I. 228
    salpingitis in children, IV. 807
    vaginitis, IV. 564
    vulvitis, IV. 524
        chronic, IV. 561
        general measures in, IV. 524
        in women, IV. 560
        local treatment, IV. 525
        treatment of by vaccines, IV. 527
    warts complicating gonorrhœa, I. 226
Gooch's splinting, I. 573
Goodall (E. W.), measles, I. 243-247
    rubella, I. 280
Gossage (Alfred M.), achondroplasia (chrondrodystrophia fœtalis), II. 1227
    acromegaly, II. 1226-1227
    angioneurotic œdema, II. 1228-1229
    cerebellar, conditions in children, II. 1165-1166
    chronic basilar meningitis, I. 253
    erythromelalgia, II. 1230-1231
    hypertrophic pulmonary osteo-arthropathy, II. 1233
    infantile convulsions, II. 986-989
    leontiasis ossea, II. 1236

- **Gossage (Alfred M.)** (*contd.*)—
  - osteitis deformans, Paget's disease, II. 1237
  - osteogenesis imperfecta, II. 1237
  - Raynaud's disease, II. 1238-1241
- **Goulard's** lotion in sprains, I. 738
- **Goundou**, III. 469
- **Gout**, I. 432–461
  - acidity in, I. 442
  - acute, calomel in, I. 432
    - colchicum in, I. 433
    - diet in, I. 434
    - lotions in, I. 433
    - massage in contra-indicated, I. 438
  - affections of the throat in, III. 775
  - alcohol in, I. 456
  - angina pectoris in, I. 443
  - cardiac form, I. 447
    - manifestations, I. 443
  - cataphoresis in, I. 441
  - causes of, I. 448
  - cerebral form of, I. 447
  - chronic, baths in, I. 439
    - diet in, I. 455
    - salts and solvents in, I. 434-436
  - climate for, III. 93
  - complications of, I. 442-447
  - diabetes in, I. 446
  - diet in, II. 207
    - alimentary tract factors, I. 450
    - animal food, I. 451
    - articles to be avoided, I. 455
    - digestibility of food, I. 448
    - fruits in, I. 454
    - general principles, I. 447
    - meals, selections for, I. 455
    - purin-free, I. 452
    - saccharine food, I. 453
    - starchy food, I. 453
  - dyspepsia in, I. 442
  - eczema in, I. 445
  - electric light baths in, I. 439
  - gastro-intestinal form of, 447
  - general principles of treatment, I. 432
  - glycosuria in, I. 446
  - hepatic torpor in, I. 442
  - hyperchlorhydria in, I. 442
  - insomnia of, I. 444
  - irregular, I. 442-447
  - lithium salts in, I. 435
  - local treatment of joints in, I. 438
  - metastatic, I. 447
  - mineral waters in, classification of value of, I. 460
    - and baths in, III. 140
  - neuritis in, I. 444 ; II. 1130
  - phlebitis in, I. 444, 1330
  - preventive treatment of, I. 437-461
  - prostatitis in, II. 926
  - pseudo-angina in, I. 444
  - retrocedent, I. 447
  - sciatica in, I. 444
  - subacute, I. 431-436
    - colchicum in, I. 434
- **Gout** (*contd.*)—
  - superheated air baths, I. 440
  - uric acid solvents in, I. 436
- **von Graefe's** cataract knife, III. 623
- **Grafting**, epithelial in avulsion of scalp, I. 875
- **Grain** poisoning, I. 506, 510
- **Grant (Dundas)**, on injection of alcohol for relief of pain, I. 135
- **Granulating** surfaces in burns and scalds, treatment of, I. 542
  - wounds, I. 554
- **Granulations** in chronic inflammation of the middle ear, III. 908
- **Granuloma**, infective, III. 447
  - ulcerating, of the pudendum, III. 457-458
- **Granulosis** rubra nasi, III. 1041
- **Graves'** disease. *See* Goître, exophthalmic.
- **Grawitz** method in pernicious anæmia, II. 9
- **Gray's** enterotribe, I. 1258
- **Green** protective, value of, I. 79
- **Greenstick** fracture, I. 570
- **Greville** non-luminous bath, I. 747
- **Grey** oil injections in syphilis, I. 319
- **Griffith's** mixture in chlorosis, II. 22
- **Grimsdale (Harold B.)**, diseases and affections of the cornea, III. 563-573
  - diseases and affections of the eyelids, III. 577-582
  - diseases and affections of the lacrymal gland, III. 556-558
- **Gritti's** transcondyloid amputation through thigh, I. 862
- **Groves (Ernest W. Hey)**, affections of the umbilicus, II. 277-281
  - fistulæ of the intestines, II. 483-492
  - foreign bodies in the intestines, II. 493-497
  - fractures of the jaws, II. 99-119
  - perforation of the intestine, II. 556-558
- **Groves'** enterotome with key, II. 489
- **Gruel**, preparation of, I. 42
- **Grünbaum (Otto)**, diseases of the adrenal glands (Addison's disease), II. 46-48
- **Guaiacum** in osteo-arthritis, I. 401
  - resin in chronic rheumatism, I. 490
  - in gout, I. 435, 438
- **Guerin's** fracture of the jaw, II. 100
- **Guillotine**, removal by, in chronic affections of the tonsil, III. 751
- **Guinea** worm, infection by, III. 501
- **Gullet**, forceps for removal of foreign bodies in, II. 184
- **Gumma**, intra-cranial, in cerebro-spinal syphilis, II. 1067
  - of the trachea, III. 801
- **Gums**, care of, in scarlet fever, I. 294
  - dental, cysts of, III. 1193
  - diseases of, dental origin, III. 1191
  - epulis of, III. 1193
  - fibroma of, III. 1193
  - laceration of, in extraction of teeth, III. 1188

ot wounds. *See under* Wounds.
erg's test in poisoning, I. 526
a oil in leprosy, III. 450
e (Thomas), syphilis of the larynx, I. 868-869
ıe naso-pharynx, III. 743
ıe nose, III. 714-715
ıe pharynx, III. 791-792
's supra-malleolar amputation, I.

astics, educational, III. 223
eformities of the spine, I. 981
lial, III. 227
lish, in constipation in adults, II. 9, 460
ılso Exercises.
ological operations, antiseptic solutions in, IV. 484
rections to nurse in, IV. 485
amination of patent before, IV. 474
ırb of surgeon and assistants in, IV. 483
struments for, IV. 475
gature, material for, IV. 482
tentive apparatus for, IV. 481
ecial apparatus for, IV. 481
erilisation in, IV. 483
abs in, IV. 483
chnique of, IV. 474-486
ery, after-treatment, IV. 487-489
adder in, IV. 487
adder, complications of, IV. 496
wels in, IV. 487
rdiac failure in, IV. 494
llulitis in, IV. 493
mplications in parietal wound in, IV. 495
of, post-operative, IV. 489-497
et in, IV. 488
stension in, IV. 490
essings in, IV. 488
moral thrombosis in, IV. 494
emorrhage in, IV. 491
somnia in, IV. 490
testinal obstruction in, IV. 493
in in, IV. 490
rotitis in, IV. 495
ritonitis in, IV. 492
sition of patient in, IV. 487
lmonary complications of, IV. 494
lse in, IV. 487
spiration rate in, IV. 487
st in bed in, IV. 489
ock in, IV. 491
mperature in, IV. 487
miting in, IV. 489
ology, light treatment in, III. 201

, vicious, natural resistance to
ıse lowered by, I. 5, 9
temesis, gastro-jejunostomy, II. 3
ncer of the stomach, II. 300
cinal treatment of, II. 328

Hæmatemesis (*contd.*)—
  post-operative, complicating abdominal operations, II. 275
  surgical treatment of, II. 332
Hæmatocele, II. 913
Hæmatoma and contusions, I. 545-546
  complicating operation for goître, II. 69
    wound after abdominal operations, II. 272
  increasing diffused, in injuries of arteries, I. 1278
  in varicose veins, IV. 90
  of the external ear, III. 888
  of the scrotum, II. 900
  of the spermatic cord, II. 917
  of the sterno-mastoid in newborn child, IV. 365
  of the vulva, IV. 522
Hæmatomata, subaponeurotic, in contusions of the scalp, I. 873
Hæmatomyelia, I. 904; II. 1210-1211
  acute stage of, II. 1210
  stage of repair in, II. 1211
Hæmatoporphyrinuria, II. 735
Hæmatosalpinx of Fallopian tube, IV. 810
Hæmaturia, II. 736
  and chronic interstitial nephritis, II. 799
  in acute nephritis, II. 797
  in scurvy, I. 475, 477
  post-operative, in renal calculus, II. 762
  renal, and calculus, II. 755
Hæmophilia, II. 31-36
  arthritis in, I. 786
  diet in, II. 35
  encouragement of coagulation locally, II. 32
  internal remedies for, II. 34
  iron in, II. 36
  local pressure in, II. 33
  local vaso-constriction in, II. 33
Hæmoptysis in pulmonary tuberculosis, I. 1150
  mild, in pulmonary tuberculosis, I. 1150
  moderate, in pulmonary tuberculosis, I. 1151
  severe cases of, in pulmonary tuberculosis, I. 1154
Hæmorrhage, accidental after labour, IV. 28, 29
    complicating pregnancy, IV. 23-29
  after amputations, I. 803
  after extraction of teeth, III. 1189
  after ovariotomy, IV. 793
  angiotripsy in, I. 1257
  ante-partum, forceps in, IV. 420
    podalic version in, IV. 466
  antiseptic action of, I. 7
  arterial, I. 1255-1277
  as symptom of cancer of cervix, IV. 585
  cerebellar, II. 1174
  cerebral, II. 1168-1176
    coma in, II. 984
    effects of, II. 1169

Hæmorrhage, cerebral (*contd.*)—
- factors underlying production of, II. 1169
- in asphyxia of newborn child, IV. 353
- in newborn child, IV. 364
- meningeal, II. 1072
- results of, I. 880
- superficial, II. 1170
- traumatic, II. 1170

cold in, I. 1260
complicating adenoma of the prostate, II. 945
- gynæcological surgery, IV. 491
- operation for goître, II. 68
- perineal prostatectomy in adenoma of prostate, II. 948
- pernicious anæmia, II. 10

concealed, after labour, IV. 28
- before labour, IV. 27
  - severe, IV. 28
- control of, in amputations, I. 798
- in disarticulation at hip joint, I. 866
- in inoperable cancer, I. 136
- in malignant disease of upper jaw, II. 116

cutaneous, in jaundice, II. 671
effect of decreased coagulability on, I. 128
Esmarck's bandage in, I. 1259
external, severe, in labour, IV. 27
- slight, after labour, IV. 28
  - before labour, IV. 26

extradural, in injuries of the head, I. 880
forci-pressure in, I. 1256
from the ear, III. 886
from varicose vein, I. 1276
from wounds, arrest of, I. 550
gastric, II. 325-330
- complications of, II. 331
- surgical treatment of, II. 331-333

gastro-intestinal post-operative, I. 1276
general treatment of, I. 15-29
hæmorrhoids and, II. 616
heat in, I. 1260
horse serum in, III. 262
immobility in, I. 1262
in aortic aneurysm, I. 1300
in cancer of cervix, IV. 617
in chronic simple ulcer of stomach, II. 327
in colitis, II. 574
in contusions and hæmatoma, limitation of, I. 545
in cut throat, II. 164
in gunshot wounds, I. 559
in nævi of the lips, II. 97
in operation for cleft palate, II. 150
in portal cirrhosis of the liver, II. 663
in uterine fibroids, IV. 637
in Wertheim's operation, IV. 607
in wounds of parotid gland, II. 162
- of the scalp, I. 874
- of the tongue, II. 132

Hæmorrhage (*contd.*)—
internal, in abdominal injuries, II. 244
- signs of, I. 29

intestinal, complicating typhoid fever, I. 359
into the spinal canal in injuries of the spine, I. 904
intra-cerebral, purgation in, II. 1171
- treatment of, general, II. 1171
  - surgical, II. 1173
- venesection in, II. 1172

intra-cranial, in head injuries in the infant, I. 886
- in infants, I. 886
- treatment of, surgical, II. 1175

intra-dural, in injuries of the head, I. 882
intra-peritoneal, complicating abdominal operations, II. 275
laryngeal, III. 824
meningeal, I. 880 ; II. 1170
mixed, after labour, IV. 28
- severe, in labour, IV. 28

mucous, in jaundice, II. 671
parenchymatous, I. 1272
pharyngeal, III. 776-777
pontine, II. 1175
position in, I. 1262
post-operative, treatment of, I. 87
post-partum, IV. 29
- bi-manual compression of uterus in, IV. 220
- complicating labour, IV. 214-223
- compression of fundus in, IV. 219
- Crede's method of expression in, IV. 218
- exciting causes of, IV. 215
- external, IV. 216
- forceps in, IV. 426
- in placenta prævia, IV. 68
- predisposing causes, IV. 215
- severe anæmia in, IV. 222
- shock in, IV. 222

primary, of arterial origin, I. 1270
reactionary, I. 1272
rest in, complete, I. 1262
rubber tourniquet for, I. 1258
saline infusion in, I. 1262
secondary, I. 1272
- in gunshot wounds, I. 559
- in hæmorrhoids, II. 619
- of the cord in newborn child, IV. 370

special, I. 1274-1277
styptics in, I. 1261
surgical methods in, I. 1255
- varieties of, 1270-1277

torsion in, I. 1257
transfusion of blood in, I. 1269
vaginal, in newborn child, IV. 371
venous, I. 1271

Hæmorrhagic diphtheria, I. 187-199
- small-pox, I. 310

Hæmorrhoids, II. 615-620
- cautery in, II. 619
- clamp for, II. 619

rhoids (*contd.*)—
licating pregnancy, IV. 42
n, II. 616
nal, II. 615
rrhage and, II. 616
female urethra, IV. 729
al, II. 615
tions in, II. 618
gnancy, IV. 42
in, II. 617
l operation for, II. 620
dary hæmorrhage in, II. 619
bosed, complicating pregnancy,
42
asis in amputation through the
, I. 824
isarticulation through shoulder-
t, I. 827
at, long, for faucial and pharyn-
se, III. 784
orax, I. 1090
itrite in, I. 564
uries of the thorax, I. 1029
re of, in sick room, I. 28
h of, excessive, III. 1046
disease of, III. 476
ls, gastric, II. 359
licles, alopecia dependent on
d conditions of, III. 1000
Arthur J.), diseases of salivary
nds, II. 130-131
aphical tongue (annulus migrans),
126-129
titis, II. 120-125
flexus, I. 965
s, I. 965
's operation for inguinal hernia,
7
Gustav), massage, III. 203-212
nder treatment, III. 369-374
nent by radiant heat and hot air,
316-326
n Irving's box, II. 943, 944
-Meskoutine spa, III. 150
-R'irha spa, III. 151
man's cramp, II. 1267
schlag on pubiotomy, IV. 449
toe, I. 966
of, I. 57
ontractures of, I. 941
ection of, in normal labour, IV.

r chamber for, in hyperæmic
tment, III. 63
sation of, I. 81
uerperal sepsis, IV. 288
in physical exercises, III. 230
(**Sampson**), on lymphangioplasty,
4
pen-air methods in inoperable
er, I. 133
ead of mammary cancer, I. 126
psin treatment in œsophageal
er, I. 140
disease, II. 664

"**Hardening**" of children, dangers of, I. 46, 50
Harelip, II. 85-95
  after-treatment in operations for, II. 93
  double, II. 89
    premaxillary bones in, II. 92
  in newborn child, IV. 357
  nostril and, II. 90
  operations and anæsthetics, III. 28
  preliminary considerations of, II. 85
  secondary operations for, II. 94
  single, II. 86
    premaxillary bones and, II. 91
Harris (Wilfred), neuralgia, II. 1114-1126
  nystagmus, II. 1140-1141
  occupation neuroses, and craft palsies, II. 1264-1268
  tetany, II. 1271
  tics and spasms, II. 1047-1049
Harrison's rubber tooth cleanser, II. 128
Harrogate spa, III. 151
Hartmann's forceps, III. 908
Haward (J. Warrington), phlebitis and thrombosis, I. 1328-1338
  on embolism following operation for appendicitis, II. 274
Hay (John), arterio-sclerosis, I. 1287-1295
Hay fever, III. 690
Haseline suppository in hæmorrhoids, II. 617
Head, diathetic neuralgia of, II. 1024
  diseases and injuries of, I. 873-887
  fœtal, after-coming, delay of, forceps in, IV. 422, 430, 432
  injuries of, in the infant, I. 886-887
    infection following, I. 884-885
  level of, to be lowered in shock, I. 97
  neuralgia, diathetic, affecting, II. 1122
    toxic, affecting, II. 1122
  oblique, forceps in, IV. 431
  pain in, hypnotism in case of, III. 172
  position of, in X-ray application for ringworm, III. 356
  preparation of for operation, I. 87
  toxic neuralgia of, II. 1024
  transverse, forceps in, IV. 432
  varix of, I. 1321
Headache from cerebral syphilis, II. 1034
  from chronic hydrocephalus, II. 1034
  from disease of nasal accessory chambers, II. 1033
    of skull bones, II. 1033
  from errors of refraction, II. 1033
  from gross intra-cranial disease, II. 1034
  from high arterial tension, II. 1034
  from inter-cranial tumour, II. 1034
  from ocular conditions, II. 1033
  from renal disease, II. 1034
  from uræmia, II. 1034
  in fever, relief of, I. 159
  in lead poisoning, I. 514
  in yellow fever, III. 412

Headache (*contd.*)—
- neuralgic, accompanied by soreness of the scalp, II. 1116
- periodic, II. 1027-1035
  - forms of, II. 1033

Head-nodding in nystagmus, II. 1141

Heart affections complicating influenza, I. 241
- scarlet fever, I. 293
- block, I. 1237
- congenital affections of, I. 1254
- continuous irregularity of, I. 1231
- dilatation of, I. 1240
  - compensatory, I. 10
- diseases of, climate for, III. 97
  - complicating pregnancy, IV. 52
    - rheumatism, acute, I. 272
  - consciousness of, I. 1245
  - dropsy in, I. 1243
  - drugs in, I. 1211, 1243
  - during labour, forceps in, IV. 420
  - following diphtheria, I. 193
  - in anæmia, II. 15
  - in typhoid fever, I. 364
  - physical exercises in, III. 249, 253
  - principles of treatment of, I. 1194-1254
  - remedial measures in, I. 1203-1211
  - subjective phenomena in, I. 1245
  - symptoms as indications for treatment, I. 1227
  - vascular, mineral baths in, III. 137
  - what to treat, I. 1194
- effect of lithium salts on, I. 435
  - thyroid extract upon, II. 49
- extra systoles of, I. 1230
- failure, I. 1195
  - causes of, I. 13
  - complicating gynæcological surgery, IV. 494
  - difficulty in estimating effects of remedies in, I. 1197
  - in chronic simple ulcer of the stomach, II. 329
  - in diphtheria, I. 199
  - in pneumonia, I. 260
  - threatened, in acute bronchitis, I. 1052
- fatty degeneration of, I. 1242
- febrile affections of, acute, I. 1242
- gout and gouty conditions of, I. 443, 447
- gunshot wounds of, I. 565
- hypertrophy of, I. 1241
- irregular action of, I. 1228-1237
- irregularity of, in arterio-sclerosis, I. 1295
- lesions in rheumatism in childhood, I. 278
- massage of, in eclampsia, IV. 37
- myocardial affections of, I. 1240
- right, dilatation of, complicating acute endocarditis, I. 1193
- rupture of, I. 1030
- sinus irregularity of, I. 1228

Heart (*contd.*)—
- stimulation of, by massage, III. 254
- valvular defects of, I. 1239
  - diseases of, and anæsthetics, III. 23
- wounds of, I. 1030

Heat, excessive, and tropical liver, II. 677
- baths in osteo-arthritis, I. 403
- exhaustion, I. 537
- flushes in the menopause, IV. 502
- in hæmorrhage, I. 1260
- iritis and, III. 585
- prickly, III. 470
- radiant, treatment by, III. 316-326
  - indications of, III. 324
- treatment of chronic rheumatism, I. 486
- use of, in sprains, I. 737
- value of foods, II. 191, 198

Heath's tonsil guillotine, III. 752

Heat-shock, I. 537

Heat-stroke, I. 538
- coma in, II. 985

Heated air, hyperæmic treatment by, III. 61

Hebosteotomy in contracted pelvis complicating labour, IV. 171

Hebra, pityriasis rubra gravis of, III. 1151

Hectine in syphilis, I. 323

Heel, big, III. 465
- painful, II. 1025
  - neuralgia in, II. 1123
- raising exercise for flat foot, III. 235

Hegar's dilators in hypertrophic pyloric stenosis, II. 343

Hellebore, black, poisoning by, I. 533
- white or green, poisoning by, I. 533

Hellier (J. B.), diseases, affections and injuries of the vulva, IV. 505-530
- infections of tuberculous or doubtful nature of vulva, IV. 508
- injuries of vulva, IV. 509-510
- innocent tumours of vulva, IV. 511-512
- malformations of vulva, IV. 513-514
- malignant disease of vulva, IV. 515-516
- pruritus vulvæ, IV. 517-519
- syphilitic affections of vulva, IV. 520-521
- varix and hæmatoma of vulva, IV. 522
- vulvitis and forms of dermatitis affecting the vulva, IV. 523-529

Helouan spa, III. 151

Hemiatrophy, facial, II. 1232

Hemiplegia, II. 1181-1190
- arthritic adhesions in, II. 1187
- ataxia in, II. 1188
- contractures in, II. 1187
- general considerations of, II. 1181
- involuntary movements in, II. 1188
- length of treatment in, II. 1189
- muscular atrophy in, II. 1187
- of children, II. 1181-1190
- pain in, II. 1188
- paralysis in, II. 1184

egia (*contd.*)—
ic. of upper limb, II. 1064
icity in, II. 1186
tomatic treatment of, II. 1184
motor disturbances in, II. 1189
e. poisoning by, I. 532
tis, amœbic, II. 676
ptosis of the liver, II. 659
tary alopecia, III. 998
tic paraplegia, II. 1249
phroditism, IV. 865-867
ewborn child, IV. 362
do-, IV. 865-867
us masculinus in, IV. 881
, II. 498-527
bri, II. 1190
hragmatic, I. 1028 ; II. 515
t inguinal, II. 508
ral, II. 509-511
eration for, II. 509, 510
rangulated, II. 522
ral considerations, II. 498
eal, II. 514
ewborn child, IV. 358
med, II. 515
inal, II. 500-509
xternal incision in operation for, II. 501
gature of sac in operation for, II. 503
f newborn child, IV. 359
perations for, other than Bassin's method, II. 507
e of direct, II. 503
paration of external oblique aponeurosis in operation for, II. 502
eparation of sac from cord in operation for, II. 502
trangulated, II. 521
uture of conjoined tendon to Poupart's ligament in operation for, II. 504, 505
rstitial, II. 508
ial, IV. 512
bar, II. 515
tructed, II. 515
urator, II. 514
uscular fibres, II. 1323
he Fallopian tube, IV. 804
he lung, I. 1027
he ovary, IV. 767
he testis, II. 901
rative treatment, II. 498
liative treatment of, II. 523
y trusses, II. 498
ineal, II. 515
ventive treatment, II. 499
r complicating gynæcological surgery, IV. 496
tic, II. 514
ngulated, II. 516-523
fter-treatment of, II. 519
auses of, II. 520
f newborn child, IV. 359
bilical, II. 511-514

Hernia, umbilical (*contd.*)—
    after-treatment of operations for, II. 513
    of newborn child, IV. 358
    operation for, II. 512
    strangulated, II. 523
  vaginal, II. 515
  ventral, II. 514
Hernial sac, appendix in, II. 410
Herpes complicating pregnancy, IV. 56
  febrile, III. 1042
  frontalis and cornea, III. 571
  of the auricle, III. 880
  of the meatus, III. 885
  of the pharynx, III. 778
  of the tympanic membrane, III. 891
  post, neuralgia, II. 1122
  zoster, II. 1096-1097 ; III. 1043
    acute stage, II. 1096
    pain in, III. 1043
    prodromal stage, II. 1096
    pustulation in, III. 1043
    sequelæ of, II. 1096
Herringham (W. P.), nephritis, acute, II. 796-797
  nephritis, chronic diffuse parenchymatous, II. 794-795
    chronic interstitial, II. 792-793
  uræmia, II. 837-839
Hertz (Arthur F.), constipation in adults, II. 439-469
Heterophoria of ocular muscles, III. 646
Hett (G. Seccombe), acute tonsillitis, III. 747-749
  chronic infections of the tonsil, III. 750-759
  diseases and affections of the lingual tonsil, III. 760-763
  diseases and affections of the uvula, III. 744-746
  syphilis, tuberculosis and tumours of tonsil, III. 756-759
Hewitt's artificial airway, III. 8
  modification of Clover's inhaler, III. 7
Hey's modification of Lisfranc's amputation, I. 840
Hiccough after ovariotomy, IV. 792
  in peritonitis, II. 639
  spasm, II. 1048
High-frequency and static wave currents in chronic synovitis and arthritis, I. 746
  currents, III. 105
Hill diarrhœa, III. 438
Hill's (Leonard), manometer, I. 1281
Hilton's method in acute abscess, I. 167
Hip, congenital dislocation of, I. 943
  deformities of in cerebral palsies of infancy, II. 1160
  dislocations of, I. 724
  flexion deformity of, II. 1062
  internal rotation of, II. 1062
  joint, disarticulation at, I. 866-872
    by anterior racket incision, I. 871

Hip joint, disarticulation at (*contd.*)—
    indications for, I. 866
    Jordan's modified method, I. 868
  tuberculous disease of, I. 752-765
Hodge's pessary in retroflexion of uterus, IV. 680
Hodgen's splint, I. 614
Hodgkins' disease, I. 1340-1343
  general treatment of, I. 1341
  medicines for, I. 1343
  surgical treatment of, I. 1341
  X-rays in, I. 1342
Holland (Eardley), management of the normal puerperium, IV. 256-271
Holmes (Gordon), amaurotic family idiocy, II. 1244
  amyotonia congenita, II. 1245
  cerebral palsies of infancy, II. 1153-1156
  chronic disorders with cerebellar symptoms, II. 1246
  family form of muscular atrophy in children, II. 1247
  family periodic paralysis, II. 1247
  Friedreich's disease, II. 1248
  hereditary spastic paraplegia, II. 1249
  Huntingdon's chorea, II. 1249
  muscular dystrophies, II. 1250, 1251
  myotonia atrophica, II. 1252
  myotonia congenita, II. 1252
  peroneal muscular atrophy, II. 1253
  sub-acute combined degenerations of the spinal cord, II. 1083-1084
  syringomyelia, II. 1219-1220
Holt (Emmett), on atropine in bed-wetting, II. 75
  on modified milk in infant feeding, II. 225
  on phenazone in whooping cough, I. 382
Homatropine in cataract, III. 618
Homburg spa, III. 151
Hood (Wharton), on sprained joints, I. 739
Hookworm disease, III. 487
Hopogan in hyperchlorhydria, I. 442
Hordeola of the eyelids, III. 579
Horder (T. J.), infective endocarditis, I. 203-208
  purulent meningitis, I. 249-253
  tuberculous meningitis, I. 248-249
Horn's catgut, sterilisation of, I. 72
  sebaceous, I. 109
Horsehair sutures, I. 86
Horse serum in hæmophilia, I. 787
  in serum therapy, III. 261
  irritating effects of, I. 193
  normal, in infective endocarditis, I. 207
Hot air apparatus for the back, III. 323
    for the shoulder, III. 323
  baths, I. 38 ; III. 128
  chambers for hyperæmic treatment, III. 62-64
Hot air (*contd.*)—
  disinfection by means of, I. 162
  douche in hyperæmic treatment, III. 65
  thermal douche bath, III. 127
  treatment by, III. 316-326
Hot bottles, use of, I. 29, 34
  pack, use of, I. 38
  water bottles, use of, I. 29, 34
Houseworkers' dermatitis, III. 1030
Housing in the tropics, III. 379
Huggard (William R.), climatology, III. 69-102
Hullux rigidus, I. 965
Humerus, fractures of, I. 586-592
  anatomical neck of, I. 587
  capitellum of, I. 595
  condyles of, I. 592-594
  in newborn child, IV. 365
  lower extremity of, I. 592
  separation of epiphyses in, I. 590, 593, 599
  shaft of, I. 590, 681
  surgical neck of, I. 589
  T-shaped, I. 595
  tuberosities of, I. 588
Hunger, sleeplessness caused by, I. 54
Huntingdon's chorea, II. 1249
Hutchinson (Jonathan), affections of the tongue, II. 132-146
Hutchison (R.) on food values, II. 198
Hydatid cysts of the breast, II. 954
    of the broad ligaments, IV. 820-821
    of the gall bladder, II. 711
    of the liver, II. 669
    of the lung, surgical treatment of, I. 1175
    of neck, II. 169
    of the scalp, I. 892
    of the skull, I. 894
  disease, prophylaxis of, III. 521
    of the spine, I. 918-919
Hydatidiform mole, IV. 59
Hydradenomata of the sweat glands, III. 1044
Hydramnios, acute, complicating pregnancy, IV. 44
  chronic, in pregnancy, IV. 43
  complicating pregnancy, IV. 43-44
  olego, complicating pregnancy, IV. 44
Hydrarthrosis, intermittent, I. 748
Hydrastis canadensis, in menorrhagia, IV. 771
  in metrorrhagia, IV. 771
Hydrencephalocele of newborn child, IV. 357
Hydrocele, II. 914-916
  encysted of the spermatic cord, II. 917
  filarial, III. 516
  of the canal of Nuck, IV. 512
  of neck, II. 169
  of newborn child, IV. 360
  palliative treatment, II. 914
  radical cure by open operation, II. 916
Hydrocephalus, II. 1191-1192
  chronic, headache from, II. 1034

phalus (*contd.*)—
l puncture on, II. 1191
na bifida, I. 915
r puncture in, II. 1191
inal treatment of, II. 1191
us complicating labour, IV. 179
born child, IV. 356
ion in, II. 1193
al treatment of, II. 1193
s drainage devices in, II. 1191
loric acid, effect in gastric func-
, II. 291
tric neurasthenia, II. 386
hoid fever, I. 355
anic acid poisoning, treatment
530
lectric baths in arthritis defor-
I. 398
gy, III. 111-147
-indications for, III. 137
ne of ions in, III. 114
tions for, III. 137
al, definition of, III. 111
phrosis, II. 770-779
nital, II. 772
obstruction in bladder, II. 773
bstruction in bony pelvis, II. 772
bstruction in the urethra, II. 772
l observations on, II. 777
stomy for, II. 779
of plastic operations for, II. 779
berrant vessels of kidney, II. 773
alculus, II. 773
novable kidney, II. 772
thy in disseminated sclerosis, II.

es dorsalis, II. 1092
ricardium, I. 1185
ritoneum, complicating cancer, I.

obia, I. 264, 265
bic serum in, I. 265
r's inoculation method in, I.

of the gall bladder, II. 710
lpinx of Fallopian tube, IV. 808
erapy in chronic synovitis and
ritis, I. 745
stipation in adults, II. 459
mnia, II. 985, 1017
ritus, III. 1100
ets, I. 478
rax, I. 1091, 1092
terio-sclerosis, I. 1294
cating cancer. I. 146
ntesis in, I. 1091
and care of infants and children,
-70
al, in cholera, III. 424
ne tropics, III. 375-385
, cystic, of fœtus, complicating
ur, IV. 180
phatic vessels, I. 1351
k, II. 169
born child, IV. 358

Hymen, atresia of, IV. 513
  imperforate, IV. 541
Hyoscine in morphinism, I. 517
Hyoscyamine or hyoscine (scopolamine), poisoning by, I. 532
Hyperacidity of the stomach, II. 360
Hyperæmia, active, in joint affections, I. 747
  Bier's treatment, III. 40-68
  of the labyrinth, III. 967
  of the larynx, III. 822
  passive. *See* Bier's treatment.
Hyperæmic treatment. *See* Bier's hyperæmic treatment.
Hyperæsthesia of the labyrinth, III. 967
  laryngeal, III. 845
  of the pharynx, III. 782
Hyperchlorhydria, I. 519
  in gout and gouty conditions, I. 442
Hyperidrosis, or excessive sweating, III. 1044, 1045
  X-rays in, III. 359
Hypermetropia, III. 536
  atropine in, III. 536
Hyperopia, III. 536
  atropine in, III. 536
Hyperphoria of ocular muscles, III. 647
Hyperplasia, chronic, of the mucous membrane of the upper respiratory tract, III. 774
Hyperpyrexia, cold water sponging in, I. 160
  complicating acute rheumatism, I. 273
    scarlet fever, I. 289
  in injuries of the spine, I. 908
  in typhoid fever, cold bath treatment, I. 348
Hypersecretion of the stomach, II. 364
Hypertension, I. 1281
  case of, I. 1282
  causes of, in arterio-sclerosis, I. 1289
Hypertonic salt waters, III. 119
Hypertrichosis, III. 1046-1052
  depilatories in, III. 1047
  electrolysis in, III. 1048
  epilation for, III. 1048
  Röntgen rays in, III. 1047
Hypertrophy of the breasts, II. 957
  of the heart, I. 1241
  promotion and maintenance of, I. 13
  recuperative process of, I. 10
Hypnotics in alcoholism, I. 500
Hypnotism and treatment by suggestion, III. 159-179
    cases of, III. 177
    conclusions, III. 175
  author's method (J. F. Woods), III. 166
  Beaunis' method of, III. 164
  Bernheim's method of, III. 164
  Braid's method of, III. 163
  Bramwell's method of, III. 165
  brief historical introduction, III. 159
  Dubois' method of, III. 166
  Esdaile's method of, III. 163

Hypnotism (*contd.*)—
  in alcoholism, I. 498
  in insomnia, II. 989, 1021
  in morphinism, I. 519
  Liébault's method of, III. 164
  Luy's method of, III. 165
  Mesmer's method of, III. 163
  methods of inducing, III. 163
  Richet's method of, III. 165
  stages of, III. 177
  Vorsin's method of, III. 165
  Wetterstrand's method of, III. 164
Hypochondriasis, sexual, in impotence, I. 232 ; II. 912
Hypodermic injection in vaccine therapy, III. 265
  syringe in cases of collapse, I. 28, 37
Hypodermoclysis, continuous, in hæmorrhage, I. 1268
  in hæmorrhage, I. 1267
Hypogastrium, prominence of, in third stage of labour, IV. 120
Hypospadias, in congenital malformations of the penis, II. 875
  in newborn child, IV. 362
Hypothermal baths, III. 126
  douche bath, III. 127
Hypotonic waters, III. 115
Hysterectomy, abdominal, in uterine fibroids, IV. 641
  instruments for, IV. 642
  preparation of patient in, IV. 641
  total, in cancer of cervix, IV. 600
  bladder reflected in, IV. 645
  broad ligaments, clamped in, IV. 642
    divided in, IV. 646
  Cæsarean, IV. 398-402
    mortality from, IV. 401
    operation of, IV. 399
  for anterior cervical fibroid, IV. 651
    precautions in, IV. 652
  for central cervical fibroid, IV. 648, 649
    precautions in, IV. 650
  for cervical fibroid, IV. 649
  for false broad ligament fibroid, IV. 654
  for posterior cervical fibroid, IV. 652
  for uterine fibroids, indications for, IV. 637
  in accidental, hæmorrhage during pregnancy, IV. 25
  in menorrhagia, IV. 763
  in metrorrhagia, IV. 763
  in puerperal sepsis, IV. 302
  in tubal pregnancy, IV. 87
  in uterine fibroids, IV. 639
  sub-total in uterine fibroids, IV. 643
    precautions in, IV. 646, 648
  total abdominal in cancer of uterus, IV. 579
    in uterine fibroids, IV. 647
  uterine vessels, clamped in, IV. 643
  uterus amputated in, IV. 644
  vaginal, cancer-cell infection of operation area, IV. 600
Hysterectomy, vaginal (*contd.*)—
    division of broad ligament in, IV. 598, 599
    in accidental hæmorrhage during pregnancy, IV. 26
    in cancer of cervix, IV. 593
      results of, IV. 597
    in cancer of uterus, IV. 578
    in fibroids, IV. 656-658
    in prolapse of uterus, IV. 693
    instruments for, IV. 655
    limits of operation and percentage operability, IV. 597
    opening utero-rectal pouch in, IV. 596
      utero-vesical pouch in, IV. 595
    operation by ligature only, IV. 655
    precautions in, IV. 657
    reflecting mucous membrane in, IV. 594
    results of, IV. 599
    transfixing lower part of broad ligament in, IV. 597
Hysteria, II. 1008-1013
  aphasia in, II. 1147
  association method in, II. 1011
  drugs in, II. 1012
  mental aspects of, II. 1306-1308
  persuasion method in, II. 1012
  physical methods in, II. 1012
  prophylactic treatment of, II. 1012
  psycho-analysis in, II. 1010
  spasm of, II. 1049
  suggestion in, II. 1009
Hysterical joint disease, I. 787
Hystero-vaginectomy in cancer of uterus, IV. 580
  operation, complications of, IV. 612
    dangers of, IV. 612
    difficulties of, IV. 612
    limits of, IV. 613
    results of, IV. 613
    technique of, IV. 612
  radical, in cancer of cervix, IV. 611

Ice-bags, application of, I. 36
  in chronic simple ulcer of the stomach, II. 328
Ice compressors, I. 36
  poultice in pneumonia, I. 259
  uses of, in sprains, I. 738
Ichthyol in erysipelas, I. 210
  in pruritus, III. 1099
Icterus, II. 670-675
  in the newly born, II. 672 ; IV. 369
  See also Jaundice.
Icthyosis, III. 1053
Ictus laryngea, III. 841
Ideas, imperative, II. 1313
Idiocy, II. 1318-1320
  amaurotic family, II. 1244
Ileo-colostomy in cancer of colon, I. 141
Ileo-sigmoidostomy in cancer of colon, I. 141
  for chronic constipation, II. 470

y, insufficiency and loss of, I.

, III. 1054-1056
l remarks on, III. 1054
reatment of, III. 1054
tion cysts, I. 110
ce, II. 911-912
al causes, I. 231 ; II. 911
al, I. 231 ; II. 911
hypochondriasis in, II. 912
omatic, I. 231 ; II. 911
scent light, concentrated, III. 196
II. 197
I. 198
, III. 186
lower, extraction of, III. 1183
. extraction of, III. 1181
ion period of whooping cough, I.

moval of, in chronic inflammation
ddle ear, III. 915
nger, amputation at metacarpo-
ngeal articulation of, I. 811
aria, II. 737
ion. *See* Dyspepsia.
ality of patient, appreciation of,

al plumbism, prevention of, I. 514
so Occupations.
y, chronic, I. 499-502
ism, II. 71
artificial feeding of, I. 58
y cirrhosis in, III. 439
feeding of, II. 215
f the mouth in, II. 120
al palsies of, II. 1055-1058, 1153-
156
ical treatment of, II. 1059-1066,
157-1164
tment of lower limbs in, II. 1159
f upper limbs in, II. 1162
lsions of, II. 986-989
idly repeated, II. 988
a in, III. 1035
ise for, I. 51
g of, II. 214-232 ; IV. 344
ast feeding best in, II. 215
ated milk in, II. 225
densed milk in, II. 227
am in, II. 227
ated milk in, II. 222
ed milk in, II. 228
ry foods in, II. 229
marasmus, I. 466
k composition in, II. 221
liluted by adding fat in, II. 223
by adding sugar in, II. 223
digested milk in, II. 226
pared foods in, II. 227
rilisation of milk in, II. 220
milk diluted by adding lactose, II.
224
ey in, II. 227
ole milk in, II. 221
th cow's milk, II. 219

Infants, feeding of (*contd.*)—
with foods containing no starch, II. 229
hygiene and care of, I. 44, 70
hypertrophic stenosis of pylorus in, II. 338
inflammation of the umbilicus in, II. 279
injuries to the head in, I. 886-887
management of during anæsthetics, III. 25
mastitis in, II. 960
newborn, absence of half diaphragm in, IV. 361
anencephalus of, IV. 357
angioma of the umbilicus in, IV. 370
asphyxia of, IV. 350-355
cerebral hæmorrhage in, IV. 353
atelectasis in, IV. 361
bath of, IV. 337
birth injuries of, IV. 363-366
brachial palsy in, IV. 365
breast, feeding of, IV. 340
cephalhæmatoma in, IV. 363
cerebral hæmorrhage in, IV. 364
cleft palate in, IV. 357
congenital defects of, IV. 355-363
syphilis in, IV. 369
constipation in, IV. 368
convulsions in, IV. 371
cystic hygroma of, IV. 358
dextrocardia in, IV. 361
diseases of, IV. 366-372
dislocations in, IV. 366
encephalocele of, IV. 357
epiphyseal separation in, IV. 366
extrophy of bladder in, IV. 360
facial palsy in, IV. 365
feeding of, IV. 341
fracture of, clavicle of, IV. 354
long bones in, IV. 365
ribs in, IV. 354
skull of, IV. 364
frequency of feeding of, IV. 341
hæmatoma of the sterno-mastoid in, IV. 365
harelip in, IV. 357
hermaphroditism in, IV. 362
hernia in, IV. 358
hydrencephalocele of, IV. 357
hydrocele in, IV. 360
hydrocephalus of, IV. 356
hypospadias in, IV. 362
icterus in, II. 672
imperforate anus in, IV. 362
infective enteritis in, IV. 367
intussusception in, IV. 371
jaundice in, IV. 369
management of, IV. 337-372
marasmus in, IV. 370
mastitis in, IV. 371
melæna in, IV. 370
meningocele of, IV. 357
nævus in, IV. 363
non-descent of the testicle in, IV. 360

Infants, newborn (*contd.*)—
ophthalmia neonatorum in, IV. 366
phimosis of, IV. 360
prepuce of, IV. 339
rickets in, IV. 371
rupture of the cord in, IV. 366
scurvy in, IV. 371
secondary hæmorrhage of the cord in, IV. 370
sepsis of the cord in, IV. 370
spina bifida in, IV. 361
strophulus in, IV. 371
supernumerary digits in, IV. 363
talipes in, IV. 362
tongue tie in, IV. 358
union of digits in, IV. 362
vaginal hæmorrhage in, IV. 371
paralysis of, nerve anastomosis in, II. 1059-1060
pyelitis in, II. 805
urinary fistulæ at the umbilicus of, II. 278
weaning of, II. 218
See also Children.
Infection, avoidance of at operations, I. 83
a principle of treatment, I. 7
following head injuries, I. 885
in gunshot wounds, I. 557
prevention of, I. 557
means of, in tetanus, I. 329
of wounds, I. 555
puerperal, IV. 282-323
Infectious cases, nursing of, I. 41
diseases, acute inflammation of middle ear, secondary to, III. 902
cold water drink in, I. 158
diet in, I. 158
general treatment of, I. 157-160
nursing of, I. 41
remediable treatment of, I. 159
Infective lesions of bones, I. 889
of the scalp, I. 888
Inflammation, conservative factor of, I. 10
in non-operative appendicitis, II. 423
Influenza, I. 233-242
bronchial catarrh in, I. 239
cardiac affections complicating, I. 241
chronic, I. 237
complications of, I. 239-242
conjunctivitis complicating, I. 239
convalescent stage of, I. 235
drugs in, I. 233, 234
enlarged cervical glands in, I. 239
frontal sinusitis complicating, I. 239
gastric, I. 236
inflammation of trachea in, III. 798
jaundice complicating, I. 241
mastoiditis in, III. 933
meningitis complicating, I. 241
middle ear disease in, I. 239
nephritis complicating, I. 241
neuralgia following, I. 242
neuritis complicating, I. 241
pharyngitis complicating, I. 239
Influenza (*contd.*)—
pneumonia complicating, I. 240
prophylaxis of, I. 237
relapsing, I. 235
vaccine therapy in, I. 235, 238
Infra-orbital foramen, alcohol injection into for neuralgia, II. 1118
Infusion, apparatus for, I. 99, 100
in shock, I. 98-103
human blood, I. 102
intra-peritoneal, I. 101
normal saline, I. 98
rectal, I. 99
subcutaneous, I. 99
methods of, I. 98, 100
Injections, intramuscular in malaria, III. 395
intra-spinal, in labour, IV. 379
intra-tracheal, I. 1149
Injuries. *See* Wounds.
Inman (A. C.), bacterio-therapeutics of diphtheria, III. 273-279
meningococcus infection, serum therapy of, III. 282-283
micrococcus catarrhalis infections, serum therapy of, III. 282-283
pneumococcus infections, III. 285-286
staphylococcus infections, vaccine therapy of, III. 288-289
tuberculosis, III. 290-295
tumours, malignant, III. 298-299
typhoid fever, III. 299-300
Inoculation of plague, point of, III. 405
preventive, in plague, III. 284
in typhoid fever, I. 348 ; III. 299
treatment of rabies, Pasteur's method, I. 264
Insane, general paralysis of, II. 1077
Insanity, II. 1274-1283
and anæsthetics, III. 25
of lactation, IV. 279
of pregnancy, IV. 45
puerperal, IV. 277-278
Insecticides in the tropics, III. 383
Insects, diseases disseminated by, in the tropics, III. 379
Insomnia, II. 1014-1024
ætiology of, II. 1014
after abdominal operations, II. 265
application of, vibration in, III. 221
cardio-vascular disease and, II. 1019
chloralamide in, I. 286, 366
complicating gynæcological surgery, IV. 490
constipation in, II. 1018
general measures in, II. 1016
hydrotherapeutic measures in, II. 1017
hypnotic drugs in, II. 1021
hypnotism in, II. 1021
in children, causes of, I. 54
in gout and gouty conditions, I. 444
in pneumonia, I. 259
in the menopause, IV. 502
simple, hypnotics for, I. 159

ia (*contd.*)—
ial causes of, II. 1018
, causes of, II. 1015
ments employed in amputations of
gers, I. 804
bdominal operations, IV. 482
lecapitation, IV. 413
ynæcological operations, IV. 475
nastoid operation, III. 921
variotomy, IV. 776
aginal operations, IV. 482
bdominal hysterectomy, IV. 642
aginal hysterectomy, IV. 655
aration of, in obstetric operations,
IV. 374
d sterilisation of, I. 28-30
ired in vaginal hysterectomy, IV.
3
ilisation of, in puerperal sepsis, IV.
8
ical, for removal of foreign bodies
in the air passages, III. 806
erilisation of, I. 72
sterile case in normal labour,
V. 95
ations, dry, in puerperal vaginitis,
563
ator for powders to the nose and
at, III. 697
ive baths, III. 126
arytenoideus muscles, paralysis of,
1844
capulo-thoracic amputation, I. 830
rigo, dusting powders for, IV. 529
inal obstruction, II. 528-540
næsthetics in operation for, III. 32
ancerous, relief of, I. 142
omplicating gynæcological surgery,
IV. 493
t, bacterial decomposition in, I.
50
ines, abscesses, with fistulæ, II. 485
bladder, fistulæ between, II. 491
female generative organs, fistulæ
etween, II. 491
hrax of, I. 179
iseptics in typhoid fever, I. 353-356
o-intoxication arising in, I. 387
nucous fistulæ of, II. 490
cer of, relief of obstruction in, I.
40
e of, after abdominal operations, II.
64
stipation in, enemata for, II. 457
trol of bowels in children, I. 53
atation of atonic in infantile con-
stipation, II. 435
eases of, II. 401
liet in, II. 208
n cholera, III. 425
pty, treatment, in typhoid fever, I.
44
ulæ of, II. 483-492
bscess with, II. 485
nastomosis operations in, II. 487

Intestines, fistulæ of (*contd.*)—
- and artificial anus, II. 488
- non-operative treatment, II. 484
- plastic operations for, II. 486
- simple external, II. 483

- foreign bodies in, II. 493-497
  - cases associated with obstructive symptoms, II. 495
    - causing inflammatory symptoms, II. 494
    - without definite symptoms, II. 493
- gunshot wounds of, I. 565
- hæmorrhage from complicating typhoid fever, I. 359
- hygiene of, in constipation in adults, II. 439
- in gynæcological surgery, IV. 487
- in normal puerperium, IV. 266
- injury of, in ovariotomy, IV. 785
- internal fistulæ of, II. 490
- lavage of, in constipation in adults, II. 467
- paralytic distension following operations, II. 271
- perforation of, II. 550-558
  - after-treatment, II. 555
  - anæsthetic in, II. 551
  - complicating typhoid fever, I. 359
  - incision in, II. 552
  - location of the lesion in, II. 552
  - mortality after operation for, II. 556
  - operation for, II. 551
  - peritoneal toilet in, II. 554
  - suture of, II. 552
- preparation of in abdominal operations, II. 259
- tæniasis in, III. 617-520
- typhoid, perforation of, II. 550

Intoxications, I. 495-502

Intracranial aneurysm, I. 1304
- complications of ear disease, 937-943
- disease, headache from, II. 1034

Intramuscular injections in syphilis, I. 318

Intraperitoneal hæmorrhage complicating abdominal operations, II. 275

Intratracheal injections in bronchiectasis, I. 1046

Intratympanic operations, III. 952

Intravenous anæsthesia, III. 35
- complications of ear disease, III. 937-943
- injection of antitoxin, dosage of, I. 192
  - in syphilis, I. 320, 322
  - in tetanus, I. 330

Intubation in laryngeal diphtheria, I. 198
- in stenosis of the larynx, III. 865
- instruments for, III. 804

Intussusception, II. 541-549
- acute, II. 541
- after-treatment of, II. 549
- closure of abdominal wound in, II. 546
- in newborn child, IV. 371
- of appendix, II. 422
- steps of the operation in, II. 543
- when irreducible, II. 546

Inunctions in diseases of children, I. 70
  in syphilis, I. 319
Iodide of potassium. *See* Potassium.
Iodides, dosage of in children's diseases, I. 67
  in cerebro-spinal syphilis, II. 1065
  in chronic rheumatism, I. 490
  in inveterate chronic glossitis, II. 136
Iodine, applications of, I. 35
  applied to the skin before operations, I. 27
  in chronic rheumatism, I. 487
  in goître, II. 62
  in syphilis, I. 321
  ions, III. 184
    in rheumatism, I. 488
  preparation of skin with, I. 74
  use of, in radical operation for cancer of breast, II. 967
Iodipin in inveterate chronic glossitis, II. 136
Iodoform gauze, composition of, I. 77
Iodo-glycerin solution, injection of in spina bifida, I. 913
Iodolysin in chronic rheumatism, I. 491
Ionic medication, III. 180-185
  in cancer, I. 153
  in chronic rheumatism, I. 488
  in leucorrhœa, IV. 573
  of boils, III. 184
  of carbuncles, III. 184
  of chronic synovitis, III. 185
  of lupus erythematosus, III. 184, 1070
  of lupus vulgaris, III. 184, 1150
  of rodent ulcer, III. 184, 1133
  of trigeminal neuralgia, III. 184
  of warts, III. 184
Ions, conversion of, I. 437
  doctrine of, in hydrology, III. 114
  mineral waters containing, I. 458
Ipecacuanha in chronic dysentery, III. 435
  in undefined tropical fevers, III. 411
  in whooping cough, I. 380
Iridectomy in mature cataract, III. 624
  preliminary, in cataract, III. 619
Iris, diseases of, III. 583-592
  injuries of, III. 591
  prolapse of, III. 591
  tumours of, III. 592
Iritis, acute, III. 583
  blisters in, III. 586
  complicating small-pox, I. 309
  dionin in, III. 586
  general treatment of, III. 583
  heat in, III. 585
  internal treatment of, III. 587
  leeches in, III. 586
  lotions in, III. 586
  recurrent, III. 589
  rheumatic, III. 587
  serous, complicating gonorrhœa, I. 229
  special varieties of, III. 587-589
  syphilitic, III. 588
  tuberculous, III. 589
  vaccine therapy of, III. 281
Iron, contra-indicated in gastric derangements, I. 65
  in atrophy of the stomach, II. 294
  in chlorosis, II. 21-25
  perchloride of, in erysipelas, I. 211
  peroxide of, hydrated, in arsenical poisoning, I. 504
Irritability in general paralysis of the insane, II. 1079
Irritant poisoning, I. 528-530
Irritation, chronic, as a cause of cancer, I. 118
  counter, in chronic synovitis and arthritis, I. 748
Irwin and Houston, on vaccine therapy in typhoid fever, I. 346
Ischæmic paralysis or Volkmann's contracture, I. 940
Ischia spa, III. 151
Ischio-rectal abscess of the anus, II. 601
Ischl spa, III. 151
Isolation in diphtheria, I. 187
  in influenza, I. 236
Isotonic waters, III. 115
Itch, coolie, III. 486
  Dhobie's, III. 478
  water, III. 486
Itching or pruritus, III. 1097-1101

Jaborandi, poisoning by, I. 533
Jackson (Chevalier), new growths of the laryngo-pharynx, III. 786
  of the larynx (malignant), III. 853-857
  of the nasal cavities, III. 692-698
  of the pharynx, III. 699-700
Jacques's catheter in cancer of the stomach, II. 306
Jaffrey (F.), dislocations, I. 713-733
  wounds of joints, I. 735-736
Janet's method of urethral irrigation, I. 224
Japanese river fever, III. 390
Jaundice, II. 670-675
  and abdominal operations, II. 258
  cancer complicating, I. 128
  catarrhal, II. 672, 673
  chronic hæmolytic, II. 674
  complicating influenza, I. 241
    pregnancy, IV. 53
  congenital syphilis and, II. 672
  cutaneous hæmorrhage in, II. 671
  diet in, II. 671
  due to biliary cancer, I. 143
  in newborn child, II. 672 ; IV. 369
  infective, of intestinal origin, II. 672
    of umbilical origin, II. 673
  mucous hæmorrhage in, II. 671
  physiological, of newborn infants, II. 672
  pruritus in, II. 670
  special forms of, II, 672
  symptomatic treatment of, II. 670

normal development of, III. 1165
osis of, II. 105
n growths of, II. 109
ıl myelomata of, II. 111
of, simple, II. 110
pment of, retarded by incorrect athing, I. 49
ation of, II. 104
tment of old unreduced cases of, II. 104
cent cases of, II. 104
lial odontomes of, II. 112
ystic disease of, II. 112
ıata of, II. 109
s ankylosis of, II. 186
res of, I. 563 ; II. 99-119
tal displacement in, II. 99
hora and, II. 100
ention of facial deformity in, II. 9
us of, II. 103
re grades of extra-articular adhe-ons in, II. 107
a's fracture of, II. 100
matory diseases of, II. 107
fracture of, II. 100
ith and without displacement, II. 101
ignant disease of, II. 113
ration of continuity of, II. 114
ıant disease of, II. 112
lity of operations on, II. 117
l growths of, II. 110
is of, II. 108
tive treatment of, II. 108
hylactic treatment of, II. 108
ions on, and anæsthetics, III. 26
ıa of, II. 109
infective diseases of, II. 109
fracture of, II. 99
gnant disease of, II. 115
ntrol of hæmorrhage in, II. 116
agnostic operations in, II. 115
nitations of operation in, II. 115
ethod of anæsthesia in, II. 117
rtial or modified operation in, II. 116
moval of lymph glands in II. 116
sults of operations for, II. 117
utine operation in, II. 118
atment, other than operative, II. 118
ration from skull in fractures, II. 0
my for cancer of the stomach, 05
ır-glass stomach, II. 334
stinal cancer, I. 140
perforation of, II. 557
od in typhoid fever, I. 347
r sand flea (dermatophiliasis), 1
bad spa, III. 151
adhesions in, anæsthetics in ations for, III. 32

Joints (*contd.*) -
care of in rheumatism in childhood, I. 279
Charcot's disease of, I. 785
chronic rheumatism of, I. 484
condition of in acute rheumatism, I. 274
diseases of, complicating typhoid fever, I. 363
electro-therapeutics in, I. 746-748
nervous mimicry of, I. 786
non-traumatic, massage in, III. 208
functional derangements of, Zander treatment in, III. 373
gouty enlargement of, I. 436
local treatment of, I. 438
gunshot wounds of, I. 562, 735
inflammation of. *See* Arthritis.
mal-positions of, in arthritis deformans, I. 397
pain in, in fracture, I. 577
sprained, I. 739
stiff, following fractures, massage in, III. 207
stiffness in, in fractures, I. 577
surgical diseases of, I. 741-788
swelling of, in gout and gouty conditions, I. 438
syphilitic, disease of, I. 784
tuberculous, I. 750-752
Bier's treatment in, I. 751
general treatment of, I. 750
operative treatment of, I. 752
tuberculin in, I. 750
vaccine therapy in, I. 750
wounds of, I. 734-736
Jones (Bence), protein in urine, II. 749
Jones (H. Lewis), electro-therapeutics, III. 103-110
ionic medication, III. 180-185
Jones (Robert), surgical treatment of cerebral palsies of infancy, II. 1157-1164
elbow halter of, I. 777
Jordan (Furneaux), method of disarticulation modified, I. 868
Jothion in chronic rheumatism, I. 488
Jumping exercises in gymnastics, III. 226
Junker's apparatus for anæsthetics, III. 14
inhaler for administration of chloroform, III. 16
metal tube for use with, III. 17
Junket, preparation of, I. 42

Kala azar, III. 391
Kangri cancer of Kashmir, I. 117
Kaolin in leucorrhœa, IV. 573
insufflations in leucorrhœa, IV. 572
Kaposi's disease, III. 1057
Karlsbad spa, III. 151
Keating-Hart on fulguration in cancer, I. 154
Keith (George and Skene), on treatment of cancer, I. 149

- **Kelly (A. Brown)**, acute catarrhal pharyngitis, III. 766-767
  - acute membranous angina, III. 771
  - acute septic inflammation of the pharynx and larynx, III. 772-773
  - chronic catarrhal pharyngitis, III. 768-769
  - hæmorrhage, pharyngeal, III. 776-777
  - herpes of the pharynx, III. 778
  - pemphigus of the pharynx, III. 788
  - retro-pharyngeal abscess, III. 789-790
  - ulcerative pharyngitis, III. 795-796
- **Keloid** in wounds, I. 556
  - of the auricle, III. 879
- **Ker (Claude)**, on stimulants in typhus fever, I. 367
  - on treatment of lobular pneumonia, I. 245
- **Keratitis**, interstitial, of the cornea, III. 568
  - sclerosing, of the cornea, III. 570
  - tuberculous, of the cornea, III. 569
  - vascular, of the cornea, III. 570
- **Keratosis** obturans of the meatus, III. 885
  - of the pharynx, III. 779
  - pharyngo, of lingual tonsil, III. 762
- **Kerion**, Röntgen rays in, III. 1129
- **Kerr (J. M. Munro)**, Cæsarean section and Cæsarean hysterectomy, IV. 382-402
- **Kidney** belt for movable kidney, II. 788
- **Kidneys**, aberrant vessels of, hydronephrosis with, II. 773
  - amyloid disease of, II. 839
  - bilateral calculi of, II. 765
  - calculus in solitary, II. 766
  - decapsulation of, in chronic Bright's disease, II. 799
    - in eclampsia, IV. 37
  - diseases of, II. 730
    - anæsthetics in, III. 24
    - associated with vascular disease, cerebral thrombosis due to, II. 1178
    - climate for, III. 101
    - complicated by cancer, I. 128
    - diphtheria, I. 201
    - headache from, II. 1034
  - effect of protein on, II. 204
  - elimination of infection by, I. 10
  - embolism of, I. 1308
  - failure of, in poisoning, I. 530, 532
  - fistulæ of, II. 767.
  - granular, water allowance in, II. 206
  - growths of, dangers of nephrectomy in, II. 833
    - results of, nephrectomy for, II. 833
  - hydronephrosis of, II. 770-779
  - injuries to, II. 250
    - with external wound, II. 783-784
      - operative treatment, II. 783
    - without external wound, II. 780-782
      - operations for, II. 780
      - results of operation, II. 781-784
  - movable, II. 785-791
    - corset for, II. 789
- **Kidneys**, movable (*contd.*)—
    - hydronephrosis with, II. 772
    - operative treatment, II. 789
    - palliative treatment, II. 786
    - results of operative treatment, II. 790
    - selection of cases of, II. 785
    - truss for, II. 787
  - nephritis of, non-tuberculous, II. 824
  - of fœtus, congenital cystic disease of, complicating labour, IV. 180
  - perinephritic abscess of, II. 801
  - secretion of in diabetes insipidus, I. 428
  - stone in. *See* Calculus, renal.
  - surgery of, in vesical cancer, I. 143
  - tuberculosis of, II. 819-829
    - after-results, of nephrectomy for, II. 828
    - bilateral, II. 823
    - nephrotomy for, II. 828
    - partial nephrectomy for, II. 822
    - primary results of nephrectomy for, II. 827
    - tuberculin treatment of, II. 820
  - tumours of, in adults, II. 830-835
      - operation for, II. 831
    - in children, II. 836
      - statistics of, II. 836
- **Kilian's** bronchoscopy, III. 806
  - operation for malformation of the nasal septum, III. 682
- **Kirstein's** lamp, III. 811
- **Kissengen** spa, III. 151
- **Kitasato's** bacillus in tetanus, I. 329
- **Klebs-Löffler** bacillus in diphtheria, I. 188
- **Knee**, congenital dislocation of, I. 949
  - contraction of, I. 950
  - dislocations of, I. 728
  - hot-air apparatus for, III. 325
  - leather splint for, I. 766
- **Knee-bending** exercise for flat foot, III. 236
- **Knee-joint**, disarticulation at, I. 859-861
    - by an anterior elliptical incision, I. 861
    - indications for, I. 859
  - hot-air chamber, in hyperæmic treatment, III. 64
  - Miller's disarticulation at, I 861
  - tuberculosis of, I. 765-772
    - amputation in, I. 771
    - caseation and suppuration in, I. 768
    - deformity after excision, I. 771
    - excision and erasion in, I. 769
    - flexion deformity of, I. 767
    - rest and fixation in, I. 765
    - synovial effusion in, I. 767
    - weight extension in, I. 767
- **Kneeling** in physical exercises, III. 229
- **Knock-knee** or genu valgum, I. 959
  - physical exercises for, III. 235
- **Koch's** new tuberculin, III. 293
  - old tuberculin, III. 293

s gastro-duodenostomy for pyloric
nosis, II. 316
tion of dislocations, I. 716
on infiltrating tuberculosis, I.
)
ortality of cancer of jaw, II. 118
s long flexible silver tracheotomy
II. 74
s flap in operation for diseases of
process, III. 924
s method in erysipelas, I. 210
tis of the vulva, IV. 508
s operation for pruritis ani, II.

ach spa, III. 151
on pubiotomy, IV. 448
n's suggestive anæsthesia, II. 117.
mask, I. 1148
s post-aural operation in diseases
stoid process, III. 922, 923
is, physical exercises for, III. 236
c pelvis complicating labour, IV.

bscess of, complicating gonorrhœa,

ernia, IV. 512
abnormalities of, excluding mal-
sentations, IV. 157
malities of maternal soft parts in,
157-160
bolism in, IV. 161-162
hetics in, IV. 376-381
a of the cervix in, IV. 158
oma of cervix in, IV. 160
lications of, excluding malpresen-
ons, IV. 157-
acted pelvis and, IV. 163-175
osis of, IV. 103
n treatment of contracted pelvis,
174
stion of uterus in, IV. 250-251
oses of pelvic bones and, IV. 174
IV. 103
ous polypus of placenta in, IV.

s in, dangers of, IV. 430
hasten delivery in interests of
hild, IV. 421
hasten delivery in interests of
other, IV. 420
le methods of delivery in, dangers
f, IV. 444
lilatation of cervix, IV. 442
souffle in, IV. 104
rrhage, accidental after, IV. 28,
29
om shortness of cord after, IV. 29
cealed, after and before, IV. 27, 28
rnal, after, before and during, IV.
-28
ed, after, IV. 28
-partum, in, IV. 29, 214-223
re, mixed, before, IV. 28

Labour (*contd.*)—
  hypodermic medication in, IV. 378
  induction of, IV. 433-437
  intra-spinal injection in, IV. 379
  inversion of uterus in, IV. 182-187
  kyphotic pelvis and, IV. 173
  lacerations of genital tract in, IV. 188-213
  malacosteon pelvis and, IV. 172
  malposition of cervical canal in, IV. 157
  management of, obstetrical bag in, IV. 93
  normal, auscultation in, IV. 103
    dilatation of os in, IV. 103
    management of, IV. 91-127
    palpation in, IV. 97, 98
    show in, IV. 103
    sterile instruments in, IV. 95
    uterine souffle in, IV. 104
  oblique pelves and, IV. 173
  obstruction of, by cystic diseases of foetus, IV. 180
    by deformity of the fœtus, IV. 176-181
    by diseases of the fœtus, IV. 176-181
    local enlargement of fœtus, IV. 179-181
    laceration of perineum in, IV. 204
      of vagina in, IV. 201, 204
      of vulva in, IV. 204
  osteomalacic pelvis and, IV. 172
  ovarian tumours complicating, IV. 773-774
  pains of, IV. 103
  paralysis associated with, IV. 280
  placental polypus in, IV. 228
  post-partum hæmorrhage in, IV. 29, 214-223
  precipitate, IV. 224
  premature induction of, dilatation of cervix in, IV. 439
    fœtal indications for, IV. 434
    for habitual death of fœtus, IV. 436
    for large fœtus, IV. 436
    in contracted pelvis, IV. 434
    in diseases of pregnancy, IV. 434
    in prolongation of pregnancy, IV. 436
    insertion of gum-elastic bougie in, IV. 437
    maternal indications for, IV. 434
    methods, IV. 437-445
    rupture of membranes in, IV. 437
  presentations in, breech, IV. 128
    brow, IV. 137-139
    deformity following, IV. 148
    face, IV. 140-143
    impacted, IV. 135
    neglected, IV. 152
    occipito-posterior, IV. 144-146
    prolapse of arm in, IV. 151
    Schatz's method in, IV. 141
    special management of, IV. 128-156
    transverse, IV. 150-153

- **Labour**, presentations in (*contd.*)—
    - twins, IV. 154-156
    - vaginal examination in, IV. 141
  - prolapse of the cord in, IV. 147-149
    - leg in, IV. 149
    - limbs in, IV. 149
  - pseudo-osteomalacic pelvis and, IV. 172
  - pubiotomy in, IV. 446-450
  - rarer forms of contracted pelvis in, IV. 172-175
  - retention of placenta complicating, IV. 225-237
  - rigidity of cervix in, functional, IV. 158
    - organic, IV. 159
  - Roberts's pelvis and, IV. 173
  - rupture of uterus in, IV. 238-247
    - incomplete, involving perineal coat only, IV. 242
    - limited to lower segment, IV. 240-241
  - severe lacerations of cervix in, IV. 189
  - spondylolisthetic pelvis and, IV. 173
  - stages of, first, breech presentation in, IV. 129
      - management of, IV. 109
    - second, breech presentation in, IV. 130
      - delivery of after-coming head in breech presentation, IV. 132, 133
      - episiotomy in, IV. 115
      - management of, IV. 110
      - nuchal position of the arm in, IV. 132
      - rupture of membranes in, IV. 112
      - support of the perineum in, IV. 113
    - third, IV. 117
      - binder in, IV. 125
      - change of shape of uterus in, IV. 120
      - control of uterus in, IV. 118
      - examination of afterbirth in, IV. 123
      - expression of placenta in, IV. 121
      - expulsion of placenta in, IV. 119
      - failure of cord to pull up with uterus in, IV. 120
      - increased mobility of uterus in, IV. 120
      - lengthening of cord in, IV. 119
      - ligature of cord in, IV. 117
      - perineum in, IV. 126
      - prominence of the hypogastrium in, IV. 120
      - retention of placenta in, IV. 229
      - rising of the fundus in, IV. 120
      - succenturiate placenta in, IV. 124
      - vulval pad in, IV. 125
  - spondylotomy in, IV. 451
  - sterilised rubber gloves in, IV. 288
  - symphysiotomy in, IV. 452-460
  - tonic contraction of uterus in, IV. 248-249
  - transverse presentation in, IV. 152
- **Labour** (*contd.*)—
  - turning in, IV. 461-473
  - unavailing at term, in extra-uterine pregnancy, IV. 87
  - uterine inertia in, IV. 252-255
  - vaginal examination in, IV. 104
  - version in, IV. 461-473
- **Laburnum**, poisoning by, I. 533
- **Labyrinth**, anæmia of, III. 967
  - concussion of, III. 968
  - destruction of, paroxysmal vertigo associated with, III. 961
  - diseases of, acute, III. 958-966
    - chronic, III. 967-976
  - hyperæmia of, III. 967
  - hyperæsthesia of, III. 967
  - hysterical deafness and, III. 968
  - injuries of, III. 969
  - Menier's disease of, III. 970
  - necrosis of, III. 965-966
  - paroxysmal vertigo of vasomotor origin, III. 958-960
  - suppuration of, III. 958-966
  - tinnitis of, III. 971-973
  - vertigo of, paroxysmal, and middle ear suppuration, III. 960-961
- **Labyrinthitis**, infective, acute, III. 961-962
  - vestibulotomy, double in, III. 962
    - inferior in, III. 962, 963
- **Lack (H. Lambert)**, epistaxis, III. 664-666
  - neuroses of the pharynx, III. 782-783
  - rhinitis, acute and chronic, III. 701-712
- **Lactic** acid in leucorrhœa, IV. 571
  - ferment preparations in leucorrhœa, IV. 571
- **Lacrymal** gland, blocking of excretory passages of, III. 556
  - diseases and affections of, III. 556-558
  - lacrymation and, III. 556
- **Lacrymation** and lacrymal gland, III. 556
- **Lactation**, insanity of, IV. 279
  - in secondary amenorrhœa, IV. 747
- **Lactose**, top milk diluted by, in infant feeding, II. 224
  - use of in prolonged pyrexia, I. 158
- **Lacto-serum** injections in arterio-sclerosis, I. 1295
- **Lake-Barwell** epiglottis punch, III. 875
- **Lake (Richard)**, chronic diseases and affections of the labyrinth, III. 967-976
  - nerve deafness or deafness due to disturbance of cochlea division of eighth nerve, III. 977-978
  - polyneuritis of the auditory nerve and affections simulating this condition, III. 977
  - syphilis of the internal ear, III. 978
- **Lake's** laryngeal punch forceps, III. 874
- **Lamalou** spa, III. 152
- **Lamb**, chemical composition of, II. 193
- **Lamblia** intestinalis in chronic dysentery, III. 436
- **Lamellar** cataract, III. 608

ectomy in gunshot injuries, I. 564
juries of the spine, I. 906
r's paralysis, II. 1080
J. Ernest), gonorrhœa, I. 223-230
tence, I. 231-232 ; II. 911-912
chancre, I. 315
ilis, I. 316-324
W. Arbuthnot), the operative treat-
ent of fractures, I. 634-693
are of the feet in children, I. 57
are of nasal passages in children, I.

inal deformity in children, I. 56
continuous subcutaneous infusion
ratus, I. 99
s method in sciatica, II. 1026
tomy, removal of appendix during,
10
eous disease (albuminoid or amyloid
neration), I. 462
gectomy, for new growths of the
ynx, III. 856
ial, for new growths of the larynx,
I. 855
gismus stridulus, III. 827
gitis, III. 831-837
e, III. 831
nic, III. 834
plicating measles, I. 245, 247
ulosa, III. 828
go-pharynx, new growths on, III.

goscope, Bruning's direct, III. 849
gotomy in epithelioma of tongue,
. 140, 143
arcoma of the tongue, II. 145
x, anæmia of, III. 822
er of, relief of obstruction in, I. 142
theria of, I. 194-199
ases of, III. 803-872
tures of, III. 825
vths of (benign), III. 846-852
alignant, III. 853-857
extrinsic cases, III. 854
intrinsic cases, III. 853
laryngectomy for, III. 855, 856
palliative treatment of, III. 856
thyrotomy in, III. 854
aorrhage from, III. 824
eræmia of, III. 822
eræsthesia of, III. 845
s of, III. 841
osy of, III. 780
as of, III. 838-839
tiple papillomata of, in children,
I. 851
cles of, intrinsic, paralysis of, III.
41-844
vous cough of, III. 840
ralgia of, III. 845
rosis of, III. 840-845
otor, III. 840
ensory, III. 844
ma of, III. 858-860
cute inflammatory, III. 858

Larynx, œdema of (*contd.*)—
acute passive, III. 860
non-infective inflammatory, III. 860
secondary inflammatory, III. 859
operations on, III. 846
pachydermia of, III. 846, 850
perichondritis of, III. 861-862
phonetic spasm of, III. 841
septic inflammation of, III. 772
singers' nodules of, III. 851
spasm of, in children, III. 827-830
spasmodic affections of, III. 840
stenosis of, cicatricial, III. 863-867
fixed dilatation in, III. 864
intermittent dilatation in, III. 865
intubation in, III. 865
tracheo-laryngotomy in, III. 866
syphilis of, III. 868-869
tuberculosis of, III. 870-875
curative local treatment of, III. 873
general treatment of, III. 871
indications for treatment in, III. 870
injection of alcohol for relief of pain in, I. 135
palliative local treatment of, III, 872
ulceration of, complicating typhoid fever, I. 361
vertigo of, III. 841
wounds of, III. 825
Larva migrans, III. 482
Lassitude in sanatorium treatment of pulmonary tuberculosis, I. 1138
Lasts, for weak foot, I. 967
Latham (Arthur), acute endocarditis, I. 1190-1193
bacilluria, II. 751
bronchitis, I. 1049-1058
congenital affections of the heart, I. 1254
general principles of serum therapy and vaccine therapy, III. 258-270
pulmonary tuberculosis, I. 1117-1126
rheumatic fever (acute), I. 268-275
serum therapy, summary of doses in, III. 301-302
tuberculosis (acute), I. 332-334
tuberculosis, tuberculin therapy of, III. 291-298
tuberculous disease of lymphatic glands, I. 1344-1347
tuberculous peritonitis, II. 645-647
tumours of the lung, I. 1174
vaccine therapy, summary of doses in, III. 301-302
Latham (P. W.), on treatment of acute rheumatism, I. 268
on the treatment of rheumatoid arthritis by counter-irritation of the spine, I. 405-407
Laurvek spa, III. 152
Lavage, gastric, in atony, II. 288
in cancer of stomach, II. 296
in chronic dilatation, II. 312
in chronic gastritis, II. 349, 353
in hypersecretion, II. 367

Lavage, gastric (*contd.*)—
    in infantile hypertrophic stenosis of the pylorus, II. 338
    in secretory disorders of the stomach, II. 361
  intestinal, in constipation, II. 467
Lavey spa, III. 152
Lawson (Arnold), cataract, III. 607-641
  diseases and affections of the iris and ciliary body, III. 583-596
  sympathetic ophthalmitis, III. 598-601
Lawson (David), sanatorium treatment of pulmonary tuberculosis, I. 1127-1158
Lazarus-Barlow's solution in hæmorrhage, I. 1267
Lead colic, I. 512
Lead in pruritus, III. 1099
  lotion in erysipelas, I. 210
  salts of, poisoning, I. 529
  unsuitable remedy for children, I. 67
Lead neuritis, II. 1137, 1139
Lead poisoning, I. 512-515
    dropped-wrist, due to, I. 991
    paralysis in, I. 513
    prevention of, I. 514
    saturnine encephalopathy in, I. 514
Leamington spa, III. 152
Leather goods, disinfection of, I. 162
Leduc's ionisation in rheumatism, I. 488
Leeches, application of, I. 35
  in iritis, III. 586
Leg, amputations through, I. 850-859
  bowing of in rickets, I. 481
  constant pain in, hypnotism in case of, III. 172
  elephantiasis of, III. 516
  exercises in defective embolism, III. 255
  protection of, in children, I. 50
  See also Fractures.
Legg (T. P.), foreign bodies in the œsophagus, II. 184-189
  goître, II. 62-71
  inflammation of parotid gland, II. 157-163
  injuries and diseases of neck, II. 164-170
  malignant disease of thyroid, II. 73-74
  simple stricture of œsophagus, II. 171-183
  surgical treatment of inflammatory affections of thyroid, II. 53
  surgical treatment of exophthalmic goître, II. 58-61
Leitch (A.), on vaccine treatment of cancer, I. 152
Leiter's cold coil apparatus, III. 919
  tubes in sprains, I. 738
Lembert's suture, II. 282
Lemonade, preparation of, I. 42
Lenharts diet, II. 210
Lenk spa, III. 152
Lens. *See* Crystalline lens.
Lentigo (freckles), III. 1058
Leontiasis ossea, II. 1236
Leopold on pubiotomy, IV. 449
Lepine (R.), on pregnancy in diabetes, I. 425
Leprosy, III. 447-453
  general treatment of, III. 448
  local treatment of, III. 450
  medicinal treatment of, III. 449
  Nastin treatment of, III. 452
  of the larynx, III. 780
  of the nose, III. 780
  of the pharynx, III. 780
  prophylaxis of, III. 447
  serum treatment of, III. 451
  surgical treatment of, III. 450
Leptothrix, III. 1058
Leube (V.) diet, II. 210
Leucocytosis, artificial, in peritonitis, II. 637
  promotion of, in infective endocarditis, I. 204
Leucomata of the tongue, II. 137
Leucoplakia, preceding carcinoma, I. 117
Leucorrhœa, IV. 555-574
  after curettage, IV. 627
  as an increase of altered secretions, IV. 558
  as an increase of the physiological secretions, IV. 556
  as a simple increase of normal secretions, IV. 557
  due to general diseases, IV. 557
  due to pathological changes in the mucosa, IV. 559
  from affections of cervix, IV. 566
  from affections of corpus uteri, IV. 568
  from Fallopian tubes, IV. 571
  from operations, IV. 570
  ionic medication in, IV. 573
  kaolin in, IV. 572
  lactic acid in, IV. 571
  lactic ferment preparations in, IV. 571
  milk, IV. 559
  normal secretions in, IV. 556
  of menopause, IV. 557
  of pregnancy, IV. 557
  post-menstrual, IV. 557
  post-sexual, IV. 557
  replacing menstruation, IV. 557
  uterine, IV. 565
    spa treatment in, IV. 571
  vaccine treatment in, IV. 572
  vaginal, IV. 561
    due to tumours, IV. 557
  vulvar, IV. 559
  yeast in, IV. 572
Leukæmia, II. 38-42
  general treatment, II. 38
  lymphatic, II. 41
  medicines in, II. 39
  pseudo-, II. 42
  spleno-medullary, II. 38
    complicating pregnancy, IV. 55
    X-rays in, III. 363
  X-rays application in, II. 39

plakia buccalis, II. 126
ıe tongue, II. 137
spa, III. 152
ı planus, III. 1061-1064
ınic, X-rays in, III. 351
ıral treatment, III. 1061
l treatment, III. 1063
ınosis in, III. 1061
. scrofulosorum, III. 1151
ıatis, III. 1154-1156
ification, III. 1059-1060
ıral treatment of, III. 1059
l treatment of, III. 1059
tgen rays in, III. 1060
ult and mesmerism, III. 161
ıod of hypnotism, III. 164
entum patella, rupture of, II. 1328
ın of arteries in hæmorrhage, I. 559
res, catgut and silk, sterilisation of,
72
ıariotomy, IV. 776
ırial for gynæcological operations,
. 482
arc, III. 186
ncentrated, III. 199
, III. 187
ıd projector, III. 188
ıe incandescent lamp in, III. 193
, III. 187
ıet, III. 187
entrated incandescent, III. 196
gy, concentrated, treatment by, III.
6
sure of the body to, III. 187
ıdescent, III. 186
l, III. 187
ıdescent lamp in, III. 193
erapeutic effect of, III. 189
ıatment by various forms of, III.
186
general exposure to, III. 187
in gynæcology, III. 201
in pulmonary tuberculosis, III. 201
in small-pox, I. 307
, treatment by, III. 194
ıutions in giving, III. 189
ston (Claude) and **S. Vere Pearson,**
treatment of pulmonary tuber-
ıis by the induction of an arti-
pneumothorax, I. 1164
diathetic neuralgia of, II. 1024
mities, application of vibration to,
. 220
l prolapse of, in labour, IV. 149
untary movements of, in hemi-
ıgia, II. 1188
and upper, varix of, I. 1311-1320
, acquired deformities of, I. 958-
970
ıgenital deformities of, I. 943-958
cerebral palsies of infancy, II.
1159
ılgia, diathetic affecting, II. 1122
ıic, affecting, II. 1122
neuralgia of, II. 1024

Limbs (*contd.*)—
upper, deformities of, I. 935-943
in cerebral palsies of infancy, II. 1162
paralytic deformities of, I. 990
spastic hemiplegia of, II. 1064
See also Arm *and* Leg.
Limp, intermittent, II. 1234-1236
Linen, small, disinfection of, I. 161
Lingual tonsil, benign tumours of, III. 762
diseases of, III. 760-763
chronic abscess of, III. 762
malignant diseases of, III. 762
tonsillotome, III. 761
tonsillitis, acute, III. 760
chronic, III. 761
Liniments in arthritis deformans, I. 396
in chronic rheumatism, I. 487
in joint affections, I. 748
salicylate, in muscular rheumatism, I. 493
Linseed poultices, I. 33
Lint, value of, I. 79
Lipomata, diffuse, thyroid extract in, I. 108
length of incision required in, I. 107
of muscle, II. 1325
of the scalp, I. 893
of the vulva, IV. 511
surgical treatment of, I. 106
Lipomatosis, symmetrical, I. 108
Lips, acquired deformities of, II. 96
carcinoma of, I. 124
diseases of, II. 85-98
epithelioma of, II. 98
inflammation of, II. 96
new growths of, II. 97
wounds of, II. 96
Lipuria, II. 737
Lisdoonvarna spa, III. 152
Lisfranc's amputation of the foot, I. 836
Cooper's modification of, I. 840
Hey's modification of, I. 840
Skey's modification of, I. 840
disarticulation of the metatarsus, I. 837-839
Lister's (Lord) amputation, I. 852
head and neck bandage, I. 87
methods of, I. 80
strong solution, preparation of, I. 73-81
transcondyloid amputation, I. 862
Liston's splint for fracture of the femur, I. 611-617
in hip disease, I. 754, 762
Lithium, ionisation with, I. 488
Litholapaxy, in vesical calculus, II. 854, 855
Lithotomy, median perineal, for vesical calculus, II. 856
supra-pubic for vesical calculus, II. 856
vaginal, IV. 877
Lithuria, II. 738
Little's palsy, I. 886
Liver, abscess of, intra-hepatic, II. 648
needle in search of pus in, II. 650
operations for, II. 652
by abdominal incision, II. 654
when pus is supra-hepatic, II. 652

Liver, abscess of (*contd.*)—
    pulmonary complications of, II. 655
    pus in, II. 649
    sub-hepatic, II. 649
    supra-hepatic, II. 648
    surgical aspects, II. 648
    symptoms which suggest operation in, II. 649
    trans-thoracic operation by incision, II. 654
    trans-thoracic operation by trocar and cannula, II. 652
  acute yellow atrophy of, II. 657-658
  amyloid, II. 675
  aneurysm of hepatic artery of, II. 667
  anomalies of, II. 659
  cirrhosis of, II. 631, 660-665
    common, II. 660-663
    complicating cancer of the breast, II. 966
    hæmorrhage in, II. 329
    infantile, III. 439
    portal, II. 660-663
      early stages of, II. 660
      hæmorrhagic tendencies in, II. 663
      late stages of, II. 662
      prophylactic treatment of, II. 660
  degeneration of, II 668
  diseases of, II. 648
    mineral waters and baths in, III. 139
  enlargement of complicating typhoid fever, I. 360
  gunshot wound of, II. 251
  fatty, II. 668
  functional derangement of, II. 668
  hepatoptosis of, II. 659
  hydatid cysts of, II. 669
    enucleation in, II. 669
    incision and drainage in, II. 669
  injuries of, II. 250
  lardaceous, II. 675
  linguiform of, II. 659
  obstruction of veins of, II. 667
  partial hepatoptosis of, II. 659
  Riedel's lobe of, II. 659
  secondary malignant growths of, II. 679
  suppurative pylephlebitis of, II. 666
  syphilitic cirrhosis of, II. 665
  tear of, II. 250
  torpor of, in gout and gouty conditions, I. 442
  tropical, II. 676-678
    and malaria, II. 676
    dyspepsia and, II. 678
    excessive heat and, II. 677
    over-eating and over-drinking, II. 677
    tumours of, II. 679
  vascular diseases of, II. 666
  wandering, II. 659
Llandrindod spa, III. 152
Llangammarch spa, III. 152
Llanwrytd spa, III, 152
Llewelyn (L. Jones), arthritis deformans, I. 391-399
Llewelyn, (L. Jones) (*contd.*)—
  osteo-arthritis, I. 400-403
  spondylitis deformans, I. 404
Lochia in normal puerperium, IV. 257, 262
Lockyer (Cuthbert) inversion of uterus in labour, IV. 182-187
  lacerations of the genital tract in labour, IV. 188-213
  post-partum hæmorrhage, IV. 214-223
  retained placenta, IV. 225-237
  rupture of the uterus, IV. 238-247
Locomotor ataxy, II. 1085-1092
Loeche-les-Bains spa, III. 152
Longhurst's combined chloroform tube and tongue depressor, III. 29
Lordosis, physical exercises for, III. 239
Loreta's operation, II. 317
  stretching operation in hypertrophic stenosis of the pylorus, II. 339, 342
Lotheissen's operation for femoral hernia, II., 511
Lotions after cataract extraction, III. 633
  boiled water in preparation of, I. 73
  evaporating, I. 36
  in acute gout, I. 433
  in herpes zoster, II. 1096
  in iritis, III. 586
  for pruritus, IV. 530
  for vulvitis, IV. 530
Love (James Kerr), deaf mutism, III. 979-981
Low (G. C.), acute dysentery, III. 428-432
  Bilharzia disease, III. 498-500
  cholera, III. 423-427
  diseases of obscure origin, III. 465-469
  epidemic gangrenous proctitis, III. 437
  filariasis, III. 503
  hill diarrhœa, III. 438
  infantile biliary cirrhosis, III. 439
  ponos, III. 440-441
  tropical liver, II. 676-678
Luc's nasal biting forceps, III. 693
Lucae's pressure probe in massage of tympanic membrane, III. 952
Lucan spa, III. 152
Lucca spa, III. 152
Luchon spa, III. 152
Ludwig's angina, treatment of, I. 183
Luff (Arthur P.), gout and gouty conditions, I. 432-461
Lumbago, mineral waters and baths in, III. 142
Lumbar puncture, II. 1025-1026
  in cerebral concussion, I. 879
  in eclampsia, IV. 38
  in hydrocephalus, II. 1191
  in meningitis, I. 251
  in tuberculous meningitis, I. 249
  methods of, I. 251-252
Lunacy in pellagra, I. 523
  See also Insanity *and* Mental diseases.
Lungs, abscess of, I. 1059
    following pneumonia, I. 1060

, abscess of (*contd.*)—
ırgical treatment of, I. 1060-1062
nomycosis of, surgical treatment of, 1175
rgillosis of, I: 1116
ectasis and collapse of, I. 1063-1065
apse of, I. 1065
gestion of, acute, I. 1076
hronic, I. 1077
ypostatic, I. 1079
nd œdema of, I. 1076-1081
ortication of, in empyema, I. 1108
ases of, I. 1059-1175
reathing exercises in, III. 249
omplicating gynæcological surgery, IV. 494
hysical exercises in, III. 249
ct of ammonia on, I. 527
bolism of, after abdominal operations, II. 275
omplicating the puerperium, IV. 324-325
ansion of, correct breathing necessary for, I. 49
n generalised empyema, I. 1104
grene of, I. 1090
nia of, I. 1027
latid cyst of, I. 1175
peracute or fulminating forms of
edema of, I. 1080
uries to, I. 1028
ema of, I. 1081
and congestion of, I. 1076-1081
ration when hepatic abscess has burst through, II. 655
perculosis of, I. 1117-1126
See also Tuberculosis, Pulmonary.
mours of, I. 1174
surgical treatment of, I. 1175
nt of expansion of, in empyema, I. 1107
s, III. 1146
uterisation in, III. 1149
usted and ulcerated, X-rays in, III. 352
asion in, III. 1149
cision in, III. 1146
nsen light in, III. 1147
quent source of carcinoma, I. 117
nisation in, III. 184, 1150
the auricle, III. 881
the larynx, III. 838-839
the nares, III. 687
the naso-pharynx, III. 742
the pharynx, III. 781
the tonsil, III. 757
the vulva, IV. 508
yrogallic acid in, III. 1150
dium in, III. 1150
ntgen rays in, III. 352, 1148
licylic acid in, III. 1150
arification in, III. 1149
lver nitrate in, III. 1150
accine therapy of, III. 1150
errucosus, X-rays in, III. 352
ienna paste in, III. 1150

Lupus erythematosus, III. 1065-1072
  direct causes, III. 1066
  Finsen light in, III. 1071
  general treatment, III. 1066
  ionic medication of, III. 184
  ionisation in, III. 1070
  local treatment, III. 1067
  predisposing causes, III. 1065
  radium in, III. 1071
  solid carbon dioxide in, III. 1071
Luxeuil-les-Bains spa, III. 153
Luy's method of hypnotism, III. 165
Lying-in, length of in normal puerperium, IV. 270
Lymph, flow of, increase of, I. 438
Lymphadenoma, I. 1341-1343
Lymphangiectasis, cavernous, of the lymphatic vessels, I. 1351
  cystic, of lymphatic vessels, I. 1351
  filarial, III. 516
  simple, of lymphatic vessels, I. 1351
Lymphangioma of neck, II. 169
  proper of lymphatic vessels, I. 1352
Lymphangiomatous tumours of the scalp, I. 893
Lymphangioplasty in brawny arm of cancer, I. 144
Lymphangitis, acute, complicating gonorrhœa, I. 226
  filarial, III. 503
  of lymphatic vessels, I. 1352
Lymphatic glands, carcinoma of, I. 124, 125
    diseases of, I. 1339-1344
      secondary to infective processes, I. 1339
    removal of in malignant disease of upper jaw, II. 116
    sarcomatous secondary deposits of, I. 125
    tuberculous disease of, I. 1344
      general measures in, I. 1345
      tuberculin in, I. 1346
    varicose, III. 516
  leukæmia, II. 41
  system, anatomy of, and permeation theory, I. 126
  vessels, I. 1351-1352
    cavernous lymphangiectasis of, I. 1351
    cystic hygroma of, I. 1351
    cystic lymphangiectasis of, I. 1351
    diseases of, I. 1339-1340
    lymphangioma proper of, I. 1352
    lymphangitis of, I. 1352
    simple lymphangiectasis of, I. 1351
Lymphorrhœa of lymphatic vessels, I. 1351
Lymphosarcoma of glands, I. 1350

McBurney's incision in appendicitis, II. 411
MacCormac (Sir W.) on cancerous secondary growths, I. 125
Macdonald (Sydney G.), calculus of the bladder, II. 852-857

Macdonald (Sidney G.) (*contd.*)—
  cystitis, II. 858-860
  diverticula and sacculi of the bladder, II. 864-865
  ectopia vesicæ, II. 866-869
  injuries of the bladder, II. 868-869
  tuberculous cystitis, II. 861-863
  tumours of the bladder, II. 870-873
McEwen's operation for inguinal hernia, II. 507
MacIntyre's splint in fractures of the femur, I. 618
Mackenzie (Hector), pleurisy and effusion (sero-fibrinous), I. 1093-1098
Mackenzie (James), general treatment of diseases and affections of the heart, I. 1194-1254
Mackenzie's laryngeal forceps, III. 847
McKenzie's pillar separator in operations on tonsil, III. 752
Mackintosh sheets, use of, I. 30, 31
Mackintoshes, arrangement of before operation, I. 84
MacLeod (J. M. H.), acne vulgaris, III. 982-990
  alopecia, III. 992-1004
  boils or furuncles, III. 1006-1111
  carbuncles, III. 1012-1014
  chromidrosis or coloured sweating, III. 1021
  comedones, III. 1022-1023
  granulosis rubra nasi, III. 1041
  hyperidrosis or excessive sweating, III. 1044-1045
  hypertrichosis, III. 1046-1052
  impetigo, III. 1054-1056
  leptothrix, III. 1058
  lichenification, III. 1059-1060
  lichen planus, III, 1061-1064
  lupus erythematosus, III. 1065-1072
  parapsoriasis, III. 1085
  pityriasis rosea, III. 1090-1091
  pruritus or itching, III. 1097-1101
  pruritus ani, III. 1102-1105
  pruritus vulvæ, III. 1106-1108
  psoriasis, III. 1109-1123
  sporotrichosis, III. 1143
  tropical skin diseases, III. 470-486
  verruga Peruviana, III. 459-460
Macnamara (E. D.), cocainism, I. 505
  dementia præcox, II. 1305
  exhaustion psychoses, II. 1299-1300
  idiocy and feeble-mindedness, II. 1318-1320
  insomnia, II. 982-992, 1014-1024
  mania, II. 1284-1289
  masturbation, II. 1316-1317
  melancholia, II. 1290-1298
  mental aspects of epilepsy, II. 1310-1312
  mental aspects of hysteria, II. 1306-1308
  mental diseases, II. 1274-1283
  morphinism, I. 516-520
Macnamara (E. D.) (*contd.*)—
  obsessive and imperative ideas, II. 1313-1314
  paranoia, II. 1309
  perversions, II. 1315
  psychoses associated with changes in thyroid gland, II. 1301-1302
  toxic psychoses, II. 1303-1304
Macrodactyly, I. 943
Maddox (E. E.), diseases and affections of the ocular muscles, III. 646-655
Madeling's deformity of the wrist, I. 939
Madura foot, III. 485
Maggots in the nose, III. 669
Magnesium in arsenical poisoning, I. 504
  peroxide, in hyperchlorhydria, I. 442
  sulphate of, in constipation in adults, II. 449
    in lead poisoning, I. 514
    in tetanus in puerperium, IV. 326
Mail-carts for young children, use of, I. 52
Maize diet, cause of pellagra, I. 521
Malacosteon pelvis complicating labour, IV. 172
"**Maladie de Woillez**," I. 1076
Malaria, III. 392-398
  after-treatment of, III. 397
  coma in, II. 985
  complicating pregnancy, IV. 48
  intramuscular injections in, III. 395
  medicinal prophylaxis of, III. 392
  mineral waters and baths in, III. 143
  neuritis in, II. 1131
  prevention of, III. 380
  prophylaxis of, III. 392
  quinine in, III. 392-394
  rectal administration of quinine in, III. 396
  spleen in, II. 81
  treatment of an attack of, III. 394
  tropical liver and, II. 676
Male fern in bilharzia disease, III. 499
Malformations of the anus, II. 613
  of the colon, II. 582-587
  of the external ear, III. 876
  of the meatus, III. 882
  of the nails, III. 1082
  of the nasal septum, III. 678
  of the nose, III. 671-677
    external and internal, III. 672-673
  of the œsophagus, II. 189
  of the teeth, III. 1165
  of the tympanic membrane, III. 891
  of the uterus, IV. 711-717
  of the vagina, IV. 541-544
  of the vulva, IV. 513-514
Malignant cyst of the neck, II. 169
  degeneration of simple tumours, I. 119
  disease, ætiology of, I. 116-119
    and cholelithiasis, II. 695
    of the appendix, II. 411
    of the auricle, III. 878
    of the breast, II. 963-975
    of the lingual tonsil, III. 762

ant disease (*contd.*)—
the naso-pharynx, III, 700
the penis, II. 877-878
the uvula, III. 746
the vulva, IV. 515-516
rays in, III. 362
See also Cancer, Sarcoma *and* Tumours.
s of the jaw, II. 110
ths, fistulæ of uterus from, IV. 68
the lower pharynx, III. 786
the maxillary antrum, III. 696
the meatus, III. 883
muscle, II. 1325
the nasal cavities, III. 694
the oro-pharynx, III. 785
the rectum, II. 625
an tumours, IV. 770
ure of the œsophagus, II. 175
urs, Coley's fluid in, III. 292
the tonsil, III. 758
ant pustule, I. 179
ering in spinal injuries, I. 901
finger, I. 943
incus, removal of, III. 913-915
ever, III. 399-400
ry artery, internal, wounds of, I

ese in chlorosis, II. 27
II. 1284-1289
, in epilepsy, II. 1005
ous, acute, II. 1289
cinal treatment of, II. 1287
eral, hypnotism in case of, III. 3
eter, Leonard Hill's, I. 1281
us, I. 463
tic treatment of, I. 466
in, I. 466
ving measles, I. 247
na bifida, I. 915
wborn child, IV. 370
ylaxis of, I. 463
ater, injections in, I. 467
ng, equipment for, I. 536
e, climate of, III. 84
bad spa, III. 153
baths, III. 129
ge and chlorosis, II. 31
pilepsy, II. 1002
emale sterility, IV. 843
ay spa, III. 153
s rubber bandage for ulcers, I. , 372
for fracture of the jaws, II. 114
rial instrument for test of blood ssure, I. 1281
use of, in surgical operations, I. 81
gag in anæsthetics, III. 2
e, III. 203-212
inal in membranous colitis, II.

abdominal operations, II. 268
formation and, I. 579

Massage (*contd.*)—
effleurage in, III. 203
friction and, III. 204
in acute anterior poliomyelitis, II. 1056
in acute gout, contra-indicated, I. 438
in adhesions of the colon, II. 559
in alopecia areata, III. 996
in arthritis deformans, I. 398
in atony of the stomach, II. 287
in chorea, II. 1263
in constipation, II. 463
in facial paralysis, II. 996, 1094
in flat foot, I. 969
in fracture of head of radius, I. 599
in non-traumatic joint affections, III. 208
in paraplegia, II. 1198
in diseases of the heart, I. 1210
in fractures, I. 577-579
in orthopædic cases, III. 233
in osteo-arthritis, I. 402
in pulmonary tuberculosis, I. 1139
in Raynaud's disease, I. 218
in rheumatism (chronic), I. 488
(muscular), I. 494
in sprains, I. 737, 740
in tabes dorsalis, II. 1091
in varix of lower extremities, I. 1312
of the breasts for painful engorgement, IV. 332
of the neck, III. 209
of the tympanic membrane, III. 952
of the tympanic ossicles, III. 952
of the uterus, in retroversion, IV. 673
petrissage and, III. 204
tapotement and, III. 204
therapeutical indications of, III. 206
vibration, III. 204
vibratory, in chronic rhinitis, III. 709
Mastitis at puberty, II. 960
chronic interstitial, II. 961
lobar. II. 961
lobular, II. 961
in infants, II. 960
in newborn child, IV. 371
in the puerperium, IV. 334-335
Mastoid abscess, Bezold's, III. 932
antrum, opening of, Schwartze's operation, III. 898
cells, inflammation of, acute primary, III. 919
suppuration of, in acute inflammation of middle ear, III. 897
operation, III. 920-921
instruments for, III. 921
preparation of patient, III. 920
periostitis, III. 919
process, diseases of, III. 919-932
after-treatment of operation cases, III. 927
Ballance's operation in, III. 929
Bergmann's post-aural operation in, III. 922, 933
Küster's post-aural operation in, III. 922, 923

Mastoid process (*contd.*)—
    Schwartze's post-aural operation in, III. 922, 923
    Stacke's post-aural operation in, III. 922, 923, 926
Mastoiditis, diabetic, III. 932
  influenzal, III. 932
  latent, III. 933
Masturbation, II. 1316, 1317
  in epilepsy, II. 992
Matas (**Rudolf**), on hæmorrhage, I. 1266, 1270
Matas's operation in traumatic aneurysms, I. 560
Metatarsals, fracture of, I. 633
Matico, infusion in epidemic gangrenous proctitis, III. 437
  in hæmorrhage, I. 1261
Matlock Bath, III. 153
Maxillary alveolus, dentigerous cyst of, III. 719
  antrum, malignant growths of, palliative treatment, III. 697
  sinus, III. 721-727
    suppuration of, III. 721
Mayer's tonsil enucleator, III. 753
Mayo's operation for umbilical hernia, II 513
  scissors, IV. 476, 477
Meals, arrangement and composition of, for diabetes, I. 414, 419
    in obesity, I. 471
  daily number of, for children, I. 62
  hypersecretion and, II. 209
  nature of, and gout, I. 449, 455
Mealies, chemical composition of, II. 195
Measles, I. 243-247
  acute inflammation of middle ear in, III. 902
  bronchitis and, I. 245
  cancrum oris complicating, I. 247
  care of eyes in, I. 246
  croup and, I. 245
  diarrhœa and, I. 246
  diet in, I. 244
  fever and, I. 244
  glandular affections in, I. 246
  laryngitis complicating, I. 245, 247
  lobular pneumonia in, I. 245
  marasmus following, I. 247
  otorrhœa in, I. 246
  quinine in convalescence from, I. 65
  stomatitis and, I. 246
Meat broths in typhoid fever, I. 342
  diet in gout, I. 452
    in sprue, III. 443
  dietary for children, directions for, I. 59
  extracts in typhoid fever, I. 342
Meatus, congenital atresia and webs of, III. 882
  cutaneous diseases of, III. 884
  diphtheria of, III. 883
  diseases of, III. 883
  eczema of, III. 886
  exostoses of, III. 883
Meatus (*contd.*)—
  fibroid polypi of, III. 882
  foreign bodies in, III. 888
  granulations of, III. 882
  hypersecretion of cerumen in, III. 884
  herpes of, III. 885
  inflammations of, III. 885
  keratosis obturans of, III. 885
  malformations of, III. 882
  malignant growths of, III. 883
  neuroses of, III. 884
  new growths of, III. 882
  otalgia of, III. 884
  otomycosis of, III. 886
  otitis externa, circumscripta of, III. 885
    croupous, III. 884
    diffusa of, III. 886
    hæmorrhagic, III. 886
  papillomata of, III. 883
  secretion of, deficient, III. 885
  stenosis of, III. 882
  syphilis of, III. 883
  vascular caruncle of, IV. 512
Medical sciences, advance of, influence of, in treatment, I. 1
Medicines. *See* Drugs.
Mechanical supports for varix of lower extremities, I. 1313
  vibration, III. 213-221
Meckel's diverticulum, II. 277
Mediastino-pericarditis, chronic and adherent pericardium, I. 1186
Mediastinum, caseating tuberculous glands in, I. 1176
  inflammation of, surgical treatment of. I. 1176
  injuries of, I. 1031
  new growth in, I. 1178
Mediterranean fever, III. 399
Melæna in newborn child, IV. 370
Melancholia, II. 1290-1298
  acute stage of, II. 1291
  electricity in, II. 1294
  feeding in, II. 1292
  opium in, 1297
  psychotherapy in, II. 1295
  hypnotism in case of, III. 171
  with delusions, hypnotism in case of, III. 173
Melanoderma, III. 1073
Melanuria, II. 741
Membrana flaccida shrapnelli, perforation of, in epitympanic suppuration, III. 912
Membranes, perforation of, in accidental hæmorrhage during pregnancy, IV. 25
  rupture of, in inducing abortion, IV. 436
    in second stage of labour, IV. 113
Menier's disease of the labyrinth, III. 970
Meningeal artery, middle, hæmorrhage from, I. 1275
Meninges cerebral, direct drainage from, in purulent meningitis, I. 252

itis, cerebro-spinal, I. 250
iplicating pregnancy, IV. 49
ic basilar, I. 253
licating diseases of the ear, III.
37-939
uenza, I. 241
hoid fever, I. 362
of infection in, I. 251
gococcus, I. 250
tive measures and general points
treatment in, I. 253
mococcus, I. 250
ent, drainage by limber puncture,
. 251
cific treatment of the infective
rocess in, I, 249
l gummatous, II. 1068
tococcus, I. 250
culous, drainage in, I. 249
n-specific measures in, I. 248
cific measures in, I. 249
gocele concealed in lipoma, I.
7
al, II. 1194
ina bifida, I. 914
wborn child, IV. 357
gococcus infection, Flexner's anti-meningitis serum in, III. 282
um therapy of, III. 282-283
ngitis, I. 250
go-encephalitis, I. 885
use, dyspepsia in, IV. 501
t on metabolism, I. 389
es of heat in, IV. 502
nnia in, IV. 502
rrhœa in, IV. 557
agement of, IV. 501-503
orrhagia in, IV. 503
tal irritability in, IV. 502
rrhagia in, IV. 503
ous depression in, IV. 502
asthenia in, IV. 503
strain in, IV. 503
sarcia abdominalis in, IV. 501
ycardia in, IV. 502
rhagia, IV. 751-764
ttage in, IV. 758
hes in, IV. 756
gs in, IV. 754
trical treatment of, IV. 762
t in, IV. 754
ral treatment, IV. 752
rastis canadensis in, IV. 755
erectomy in, IV. 763
he menopause, IV. 503
uberty, IV. 501
a-uterine applications in, IV. 758
horectomy in, IV. 763
gging in, IV. 757
ming the uterus in, IV. 760
rhœa, crypto-, IV. 732
ruation, disorders of, IV. 725-764
blishment of, IV. 499
len, IV. 732
orrhœa replacing, IV. 567

- **Menstruation** (*contd.*)—
  - operations during, III. 24
  - scanty, IV. 725, 734
- **Mental** aspects of epilepsy, II. 1310-1312
    - of hysteria, II. 1306-1308
  - cough in pulmonary tuberculosis, I. 1144
  - diseases, II. 1274-1283
    - certification in, II. 1278
    - general considerations of, II. 1274
    - in pregnant women, IV. 46-58
    - prophylaxis of, II. 1279
      - *See also* Insanity, &c.
  - irritability in the menopause, IV. 502
  - torticollis, II. 1052
- **Mercurial** inunctions, I. 70
    - in disseminated sclerosis, II. 1072
    - in syphilis, I. 319
  - ointment in goître, II. 63
  - poisoning, treatment of, I. 530
  - purgatives in constipation in adults, II. 450
  - stomatitis, II. 125
- **Mercury**, biniodide of, in treatment of actinomycosis, I. 177
    - effect of, on children, I. 68
    - in arterio-sclerosis, I. 1292
    - in cerebro-spinal syphilis, II. 1065
    - in syphilitic affections of the vulva, 520
      - ulcers of tongue, II. 135
    - in tabes dorsalis, II. 1086
    - in undefined tropical fevers, III. 410
  - percentage of in cyanide gauze, I. 76
  - perchloride of, as disinfectant, I. 339
    - in lotions, I. 73
    - strength of solution, I. 81
    - in typhoid fever, I. 353
    - in trypanosomiasis, III. 421
  - treatment of syphilis by, I. 317
- **Mesenteric** arteries, embolism of, I. 1307
- **Mesentery**, injuries to, II. 252
- **Mesmer's** method of inducing hypnotism, III. 163
- **Mesocolon**, operation for shortening, in volvulus of colon, II. 592
- **Mesometrium**, cyst of, IV. 769
- **Mesosalpinx**, cyst of, IV. 768
- **Mesotan** liniment in rheumatism, I. 487
- **Metabolism**, defective, exercises in diseases associated with, III. 254
  - disorders of, in constitutional diseases, I. 386-390
  - influence of climate on, I. 460
- **Metacarpal** bones, fractures of, I. 604
  - bone, excision of head of, I. 810
- **Metacarpo-phalangeal** joints, amputation and disarticulation at, I. 807-811
- **Metal** splints for fractures, I. 574
  - suspension splint for the ankle, I. 773
- **Metallic** poisoning due to poisonous metals in tinned foods, I. 510
- **Metals**, poisonous, in tinned foods, poisoning due to, I. 510

Metastasis of carcinoma, permeation theory of, I. 124, 126
Metatarsalgia, Morton's neuralgia, I. 964
Metatarsus, amputation of, I. 830
  disease of, I. 773
  Lisfranc's disarticulation of, I. 837-839
Metchnikoff's curdled milk in achylia, II. 295
  sour milk in cancer of the stomach, II. 298
Methyl, bichlorinated chlorate as anæsthetic, III. 13
Methylene blue in bilharzia disease, III. 499
  in chronic dysentery, III. 436
Metritis, sterility and, IV. 845
Metrorrhagia, IV. 751-764
  curettage in, IV. 758
  douches in, IV. 756
  drugs in, IV. 754
  electrical treatment of, IV. 762
  ergot in, IV. 754
  general treatment, IV. 752
  hydrastis canadensis in, IV. 755
  hysterectomy in, IV. 763
  in the menopause, IV. 503
  intra-uterine applications in, IV. 758
  oöphorectomy in, IV. 763
  plugging in, IV. 757
  steaming the uterus in, IV. 760
Micrococcus catarrhalis infections, vaccine therapy of, III. 283
  melitensis in goat's milk, III. 384
  neoformans vaccine in cancer, I. 152
  vaccine therapy of, III. 299
Micro-organisms, virulent, conservative factors of resistance to, I. 10, 11
Micturition, frequency of, in pendulous belly during pregnancy, IV. 61
  obstruction of, due to premature enlargement of the prostate, II. 930
  precipitate, in myelitis, II. 1218
Mid-tarsal joint, Chopart's disarticulation at, I. 840
Middledorf's triangle, use of, in fractures, I. 591
Migraine, II. 1027-1035
  drugs in, II. 1029
  exciting causes of attack, II. 1027
  fatigue in, II. 1027
  functional troubles of the eyes in, III. 545
  ophthalmoplegic, II. 1033
  surgical procedures for, II. 1031
  treatment of attacks of, II. 1031
    between attacks, II. 1029
Miliary or generalised tuberculosis, I. 332
Milium, III. 1073
Milligan (William), cholesteatoma, III. 934
  chronic suppurative inflammation of the middle ear, III. 904-918
  diseases of the mastoid process, III. 919-933
Milligan (William) (*contd.*)—
  tuberculous disease of the middle ear and its accessory cavities, III. 935-936
Milligan's flap in operation for diseases of mastoid process, III. 924, 952
  intra-tympanic syringe, III. 906
Milk, boiled, in the tropics, III. 384
  carrier of typhoid, I. 337
  citrated, in infant feeding, II. 225
  composition of, in infant feeding, II. 221
  condensed chemical composition of, II. 194
    in infant feeding, II. 227
  cow's, in infant feeding, II. 219
  diet, additions to in fevers, I. 158
    for infants, I. 59
    in arthritis deformans, I. 393
    in chronic dysentery, III. 434
    in gastric cancer, II. 297
      neurasthenia, II. 355
      ulcer, II. 210
    in gout, I. 452
    in pellagra, I. 522
    in scurvy, I. 475
    in sprue, III. 442
    in typhoid fever, I. 340
  diluted by adding fat in infant feeding, II. 223
    by adding sugar in infant feeding, II. 223
    in infant feeding, II. 222
  disordered digestion, due to, I. 61
  dried, II. 228
    in infant feeding, II. 228
  effects upon digestion of young children, I. 60
  foods in marasmus, I. 466
  human, best for infants, II. 215-218
  in food fever, II. 237
  in hill diarrhœa, III. 438
  in pneumonia, I. 258
  Metchnikoff's sour, in cancer of the stomach, II. 298
  Pasteurisation of, II. 220
  peptonised, preparation of, I. 42
  predigested, in infant feeding, II. 226
  soured, in achylia, II. 295
    in sprue, III. 445
  sterilisation of, in infant feeding, II. 220; IV. 345
  various forms of, in infant feeding, II. 221
  whole, in infant feeding, II. 221
Miller's disarticulation at the knee by a circular incision, I. 861
Milne (Robert), on inunction of eucalyptus oil in scarlet fever, I. 288
Mimicry, nervous, of joint disease, I. 787-788
Mind, effect on temperature by, I. 1141
Mineral acids, poisoning by, treatment of, I. 526
  springs, general characters of, III. 114

(*contd.*)—
, classification of, in treatment of ut, I. 460
·ute gastritis, II. 351
thritis deformans, I. 398
ony of stomach, II. 289
ıronic rheumatism, I. 491
ɔut, I. 457
ɔesity, I. 470, 471
nal, III. 116
:ity of, III. 115
of, III. 116
ıation of springs, III. 114
ermatitis, III. 1030
mus, II. 1140
lodged, I. 558
life, effect upon the nervous , I. 8
ıanti-thyroid serum in exophthal-ïtre, II. 56
a, III. 153
ots, upper, extraction of, III.
ɔwer, extraction of, III. 1185
l, extraction of, III. 1186
first and second extraction of, [. 1182
, extraction of, III. 1183
I. 1077-1081
·r carneous, IV. 59
ıs, complicating pregnancy, IV.
liform, IV. 59
ted, III. 1080
ır, IV. 59
ossium complicating pregnancy,
n contagiosum, III. 1073
n, III. 1074
est forms of, I. 112
ix, III. 1075
t (**K. W.**), injuries and diseases ıead, I. 872-887
ano spa, III. 153
e spa, III. 153
tini spa, III. 153
moist applications in small-306
ılcer of the cornea, III. 566
ıent in chronic injections of the II. 751
on aortic aneurysm, I. 1297
nd Harvey on bacillus typhosus,
hypodermic injection of, I. 134
e operation, I. 84
·idental hæmorrhage during ancy, IV. 26
ipation in adults, II. 446
ıpsia, IV. 36
ŗnant disease of the thyroid, I.
ɔnitis, II. 638
ı of, in morphinism, I. 519
ıg by, coma in, II, 984

Morphia (*contd.*)—
- prevention of shock by, I. 96
- use of, in blackwater fever, III. 388

Morphine and scopolamine, injection of, in labour, IV. 378
- in asthma, I. 1038
- poisoning by, I. 531

Morphinism, I. 516-520
- hyoscine in, I. 517
- psychotherapy in, I. 519

Morphœa, III. 1075

Mortality after operation for perforation of the intestine, II. 556
- from gastric cancer, II. 302
- in abdominal injuries, II. 243
- of nephrectomy, II. 827
- of operations on jaws, II. 117
- of scarlet fever, I. 287
- of typhoid fever, I. 335

Morton's fluid. *See* Iodo-glycerin.
- neuralgia, I. 964

Motion, disorders of, II. 1257

Moullin (**Mansell**) on sprains, I. 738

Moure's operation on the nasal septum, III. 681

Mouth-breathing in anæmia, II. 14
  - in children, prevention of, I. 49
- care of, after abdominal operations, II. 264
  - in children, I. 49
- diseases of, II. 120-129
- dry, in inflammation of parotid glands, II. 163
  - xerostomia, II. 130
- epithelioma of tongue invading floor of, II. 143
- floor of, cysts of, II. 145
  - ranula cyst of, II. 145
- hygiene of, III. 1170
  - in sprue, III. 445
  - in syphilis, I. 318
  - in typhoid fever, I. 356
- operation on, and anæsthetics, III. 26
- -prop, wooden, in anæsthetics, III. 1
- sepsis of, II. 127
- voice production and, III. 336
- washes, II. 121, 135
  - antiseptic, I. 259
  - in scarlet fever, I. 285
  - in syphilis, I. 324

Movements, heavy, in physical exercises, III. 225
- passive, in acute anterior polio-myelitis, II. 1056

Moynihan (**B. G. A.**) on gastrectomy in gastric cancer, I. 140

Mud baths, III. 136
- in arthritis deformans, I. 398

Mules' operation for enucleation of the eyeball, III. 660

Mummery (**P. Lockhart**), adhesions of the colon, II. 559-561
- cancer of the colon, II. 578-584
- congenital abnormalities of the colon, II. 585-587

Mummery (P. Lockhart) (*contd.*)—
multiple polypi of the colon, II. 588
operative treatment of chronic constipation due to disease or abnormalities of the colon, II. 470
perforating ulcer of the colon, II. 589
shock and collapse, I. 93-105
treatment of colitis, II. 570
surgical treatment of enteroptosis, I. 431
tuberculosis of the colon, II. 590
volvulus of the colon, II. 591
Mumps, I. 256-257
simple and secondary, II. 157
Muriated baths, III. 130
Murphy's method of artificial pneumothorax, I. 1170
Murray (George R.) chronic polycythæmia with cyanosis and enlarged spleen, II. 84
Hodgkin's disease (lymphadenoma), I. 1341-1343
leukæmia, II. 38-42
purpura, II. 43-45
splenomegaly, II. 82-83
Muscles, abdominal, rupture of, II. 252
  weak electricity in, II. 465
affections of, II. 1321
atrophy of, II. 1252
  and contractions of, in fractures, I. 577
  in hemiplegia, II. 1187
  peroneal, II. 1253
  progressive, II. 1081-1082
calf, spasm of, II. 1160
  in cerebral palsies of infancy, II. 1160
contraction of, in fractures, I. 570
  static, physical exercises for, III. 229
contusions of, II. 1321
cysts of, II. 1325
dystrophy of, II. 1250-1251
  development of contractures in, II. 1251
education of, in cerebral palsies of infancy, II. 1161
facial, paralysis of, II. 995
fibromata of, II. 1325
flaps of, in amputations, I. 796
functions of, disorders of, II. 1254
inflammatory affections of, II. 1324-1325
injuries of, II. 1321-1323
laryngeal, intrinsic, paralysis of, III. 841-844
lipomata of, II. 1325
malignant new growths of, II. 1325
massage of, III. 205
new growths of, II. 1325
  innocent, II. 1325
ocular, cyclophoria of, III. 648
  diseases of, III. 646-655
  esophoria of, III. 646
  exophoria of, III. 647
  heterophoria of, III. 646
Muscles, ocular (*contd.*)—
  hyperphoria of, III. 647
  migrainous recurrent paralysis of, III. 649
  nystagmus and, III. 649
  ophthalmoplegia of, III. 649
  paralysis of, acute nuclear, III. 649
  hæmorrhagic, III. 648
  paralytic diplopia of, III. 649
  post-diphtheritic paralysis of, III. 649
  primary nerve degenerations of, III. 649
  ptosis of, III. 650
  rheumatic paralysis of, III. 649
  thrombotic paralysis of, III. 648
pectoral, removal of, in malignant disease of breast, II. 971, 972
rupture of, II. 1322
sarcoma of, II. 1325
spasm of weight-extension in, I. 742
wasting of in sprains, I. 739
wounds of, II. 1321
Muscular atrophy in children, II. 1247
  progressive, II. 1081
exercises, physiological effect of, III. 206
fibres, hernia of, II. 1323
reaction, I. 16
rheumatism, I. 492-494
Musculo-spiral nerve, injuries of, II. 1112
Mushroom poisoning causing diarrhœa, II. 480
Mustard bath for children, I. 38
leaves, I. 36
plasters, I. 36
poultice, I. 34
  in catarrhal pneumonia, I. 69
Mutton, chemical composition of, II. 193
in dietary of children, I. 59
Myasthenia gastrica, II. 286
gravis, II. 1254
Mycetoma or madura foot, III. 485
Mycosis fungoides, III. 1076
Röntgen rays in, III. 1076
Mydriatics in acute iritis, III. 583
Myelitis, II. 1212-1218
acute stage of, II. 1213
atrophic flaccid palsy in, II. 1217
bedsores in, II. 1218
bronchitis in, II. 1216
chronic stage of, II. 1216
cystitis in, II. 1217
diet in, II. 1216
drugs in, II. 1215
local treatment of, II. 1216
pain in, II. 1215
precipitate micturition in, II. 1218
prophylaxis of, II. 1212
spasticity in, II. 1217
Myeloid sarcomata of the jaw, II. 110
Myeloma of the bones of the skull, I. 895
Myelomata, central, of the jaw, II. 111
of bones, I. 710
Myiasis, III. 483

rdial affections, I. 1240
rditis in acute rheumatism, I. 272
nus spasm, II. 1049
ata of the skin, III. 1057
e vagina, IV. 553
ectomy, abdominal, IV. 658
n fibroid is pedunculated, IV. 658
sessile, IV. 658
terine fibroids, IV. 658
a, III. 538
, III. 541
scission in, III. 541
moval of lens in, III. 541
tis, acute simple, II. 1324
ppurative, II. 1324
ying, II. 1325
matic, II. 1324
ilitic, II. 1324
nia atrophica, II. 1252
genita, II. 1252
gitis of the tympanic membrane, 891
dema and cretinism, II. 72
plicating pregnancy, IV. 58

-lymphangioma, radium therapy II. 314
III. 1077-1081
llary, II. 133
nall, III. 1078
carbon dioxide snow in, III. 1078
electrolysis in, III. 1079
excision of, III. 1080
radium in, III. 1079
vaccination in, III. 1080
rnous, II. 133
ewborn child, IV. 363
phatic, II. 133
e lips, II. 97
e tongue, II. 133
er, III. 1077
ate. III. 1077
atrophy of, III. 1082
nic affections of, X-rays in, III. 1
ses of, III. 1082
ma of, III. 1082
of, III. 1082
rtrophy of, III. 1082
rmation of, III. 1082
ion of, during X-rays applications, I. 351
iasis of, III. 1121
worm of, III. 1012, 1131
ics, poisoning by, I. 530-534
lupus of, III. 687
rculosis of, III. 687, 688
accessory chambers, diseases of,
adache from, II. 1033
s, fractures of, III. 671
rrh and Eustachian obstruction, III. 945
ucopurulent. chronic and Eustachian obstruction, III. 946

Nasal (*contd.*)—
feeding, method of, I. 33
passages in children, care of, I. 49
secretion clearance of in children, I. 49
septum, dislocation of, III. 679
fractures of, III. 679
Gleason's operation on, III. 681
injuries and malformations of, III. 678
malformation of, Kilian's method in, III. 683
symptoms requiring treatment, III. 678
Moure's operation on, III. 681
simple crest operation on, III. 680
submucous resection of, III. 682
splint for fracture of the nose, III. 671
Naso-pharyngeal catarrh, III. 739-741
chronic and Eustachian obstruction, III. 946
Eustachian obstruction and, III. 945
cavity, diseases of, III. 732-743
wool-carriers, III. 740
Naso-pharynx, adhesions of, and Eustachian obstruction, III. 947
growths of, III. 699
in asthma, morbid conditions of, I. 1037
lupus of, III. 742
malignant disease of, III. 700
syphilis of, III. 743
tuberculosis of, III. 742
tumours of, and Eustachian obstruction, III. 947
voice production and, III. 336
Nastin treatment of leprosy, III. 452
Nature, influence of in treatment, I. 1
Nauheim spa, III. 153
Nausea in disordered digestion, II. 373
Neck, acute cellulitis of, dangerous for anæsthesia, III. 23
aërial fistula of, II. 166
blood cysts of, II. 167
branchial cysts of, II. 167
fistulæ of, II. 166
bursal cyst of, II. 168
cellulitis of, complicating scarlet fever, I. 290
cystic hygroma of. II. 169
cysts of, II. 167-170
dermoid cyst of, II. 168
diffuse lipomata of, I. 107
diseases of, II. 164-170
enlarged glands in, in anæmia, II. 14
fistulæ of, II. 166-167
gunshot wounds of, I. 564
hydatid cysts of, II. 169
hydroceles of, II. 169
injuries of, II. 164-170
lymphangioma of, II. 169
lymphatics of, in epithelioma of tongue, II. 144
malignant cysts of, II. 169
massage of, III. 209
median cervical fistula of, II. 167

Neck (*contd.*)—
  preparation of for operation, I. 88
  sebaceous cysts of, II. 170
  septic cellulitis of, complicating cut throat, II. 165
  thyro-glossal cysts of, II. 170
    fistula of, II. 167
  thyro-hyoid cyst of, II. 168
  thyroid cysts of, II. 170
    fistula of, II. 167
  tics of, II. 1052
  varix of, I. 1321
Necrosis in acute abscess, I. 167, 171
  in syphilis of ribs and sternum, I. 1032
  of the jaw, II. 108
  of the labyrinth, III. 965-966
Needle carrier for Gigli's saw in pubiotomy, IV. 448, 449
Nenndorff spa, III. 153
Nepenthe for relief of pain, I. 134
Nephrectomy, dangers of, in renal growths, II. 833
  for primary tuberculosis of the kidney, immediate mortality in, II. 827
  for renal calculus, II. 765, 779
  for tuberculous disease of the kidney, II. 825
  in pyonephrosis, II. 817
  partial, in tuberculosis of the kidney, II. 822
  results of, for primary tuberculosis of the kidney, II. 827
Nephritis, acute, II. 796-797, 798
  chronic diffuse parenchymatous, II. 794-795
    interstitial, II. 792-793
      with hæmaturia, II. 799
    results of operative treatment, II. 890
    with pain, II. 799
  complicating diabetes mellitus, I. 426
    diphtheria, I. 202
    influenza, I. 241
    scarlet fever, I. 292
  diet in, II. 204
  non-suppurative, surgical treatment of, II. 798-800
Nephro-cysto anastomosis, II. 777
Nephrolithotomy, dangers of, II. 761
  for renal calculus, II. 759, 764
Nephropexy in intermittent hydronephrosis, II. 774
Nephrostomy for hydronephrosis, II. 779
  in pyonephrosis, II. 815
Nephrotomy for tuberculosis of the kidney, II. 828
  in urinary obstruction due to cancer, I. 143
Néris spa, III. 153
Nerve anastomosis in infantile paralysis, II. 1059-1060
    in nerve injuries, II. 1104
  auditory, polyneuritis of, III. 977
Nerve (*contd.*)
  bridging in injuries of nerves, II. 110
  circumflex, injuries of, II. 1111
  deafness due to disturbance of cochlea division of the eighth nerve, III. 977
  facial, injuries of, II. 1108
  musculo-spiral, injuries of, II. 1112
  ocular, primary degeneration of, III. 649
  of Bell, injuries of, II. 1112
  optic, diseases of, III. 645
  posterior thoracic, injuries of, II. 1112
  ulnar, injuries of, II. 1112
Nerves, concussion of, I. 560
  derangement of, massage in, III. 210
  diffuse neuroma of, II. 1142
  diseases of, II. 1093
  division of, for relief of pain, in inoperable cancer, I. 135
    in amputations, I. 802
    in Berger's operation, I. 831
    posterior roots of, in neuritis, II. 1035
  effect of massage on, III. 205
  general considerations regarding operations upon, II. 1001
  injection of alcohol into, I. 135
  injuries of, II. 1098-1105
    anastomosis in, II. 1006
    complicating dislocations, II. 1102
    general lines of treatment in, II. 1098
    in fractures, II. 1101
    in gunshot wounds, I. 560
    in wounds, II. 1099
    nerve anastomosis, II. 1104
    nerve-bridging in, II. 1103
    secondary suture in, II. 1102
    subcutaneous, II. 1100
  malignant tumours of, II. 1142
  musculo-spiral injury to, in fracture I. 592
  neuro-fibromatosis of, II. 1142
  neuromata of, circumscribed, II. 1142
  operations on, II. 1099
  paralysis of, deformities due to, I. 988-990
  posterior roots of, division of, i neuritis, II. 1133
  rest to affected portion of, in neuriti II. 1033
  secondary suture of, II. 1102
  special, injuries of, II. 1108-1113
  subcutaneous injuries to, II. 1100
  suture of, secondary, II. 1102
  tumours of, II. 1142
    circumscribed neuromata, II. 1142
    malignant, II. 1142
Nervous depression in the menopaus IV. 502
  diseases, climate for, III. 99
    complicating pregnancy, IV. 50

ous (*contd.*)—
nptoms complicating pernicious næmia, II. 10
tem, affections of, electro-therapeutics in, III. 108
entral, diseases of, nystagmus in, II. 1140
nystagmus in disease of, II. 1042
lerangement of, massage and, III. 210 .
iseases of, II. 1014
general, II. 1054
physical exercises in, III. 256
isorders of, mineral waters and baths in, III. 146
ffect of alcoholism upon, I. 496
electric shock on, I. 548
n typhoid fever, I. 362
nfluence of on process of repair, I. 12
rogressive chronic, physical exercises in, III. 256
rain of, causes of, I. 8
ahr spa, III. 153
ann syringe, III. 913
lgia, II. 1114-1126
chial, II. 1121
plicating diabetes mellitus, I. 426
tal, II. 1114
hetic, affecting head, II. 1122
limbs, II. 1122
al, hypnotism in case of, III. 170
rgical treatment of, II. 1127
wing influenza, I. 242
lache accompanied by soreness of alp in, II. 1117
ramen ovale, II. 1119
ramen rotundum, II. 1118
nfra-orbital foramen, II. 1118
ngeal, III. 845
ntenance of trophic condition of rts supplied by affected nerve in, . 1132
mmary, II. 976
pital, II. 1120
e pharynx, III. 782
pra-orbital notch, II. 1117
e third division, II. 1119
ful heel in, II. 1123
-herpetic, II. 1122
ular, II. 1121
a-orbital, II. 1115
riodic, II. 1115
ical treatment of, II. 1117, 1127-29
collis in, II. 1050
, affecting head, II. 1122
ecting limbs, II. 1122
minal, II. 1116
ohol injection in, II. 1117
ugs in, II. 1116
cision of gasserian ganglion for, II. 1128
t-air douche for. III. 66
ic medication of, III. 184

Neuralgia, trigeminal (*contd.*)—
visceral, II. 1122
Neurasthenia, II. 1038-1043
anorexia nervosa, II. 1042
gastric, II. 354
diet in, II. 355
electricity in, II. 354
medicinal treatment of, II. 356
in the menopause, IV. 503
phosphaturia and, II. 748
traumatic, II. 1042
Weir Mitchell method in, II. 1040
Neuritis, II. 1130-1132
alcoholic, II. 1134
contractures in, II. 1135
deformity in, II. 1135
drugs in, II. 1135
application of vibration in, III. 221
arsenical, II. 1138
beri-beri and, II. 1139
chronic, of ulnar nerve at the elbow, II. 1112
complicating influenza, I. 241
compression, II. 1131
diabetic, II. 1131
division of posterior roots in, II. 1033
gouty, I. 444; II. 1130
lead, II. 1137
local, II. 1130
removal of cause in, II. 1130
malarial, II. 1131
multiple, II. 1134-1139
arising from unknown cause, II. 1139
optic, III. 645
complicating typhoid fever, I. 363
in tumours of brain, II. 1201
post-diphtheritic, II. 1138
prevention of deformity in the paralysis of, II. 1132
puerperal, II. 1139
rest to affected portion of nerve in, II. 1131
retro-bulbar, III. 645
rheumatic, II. 1130
sciatic, old-standing chronic, II. 1125
senile, II. 1139
syphilitic, II. 1130
traumatic, II. 1106-1107
Neuro-fibroma, plexiform, I. 112
varieties of, I. 112
Neuro-fibromatosis of nerves, II. 1142
Neuro-fibromatous tumours of the scalp I. 893
Neuroma, diffuse, of nerves, II. 1142
Neuromata, amputation, I. 112
circumscribed, of nerves, II. 1142
Neuropathic arthritis, I. 785
Neuroses following spinal injury, I. 899
motor, of the larynx, III. 840
nasal, III. 689
of occupation, II. 1264
of the heart, I. 1252
of the larynx, III. 840-845

- **Neuroses** (*contd.*)—
  - of the meatus, III. 884
  - of the pharynx, III. 782-783
  - of the skin, III. 998
  - rectal, II. 614
  - sensory, of the larynx, III. 844
  - vasomotor, II. 1242-1243
- **Nicoll's** operation for inguinal hernia II. 511
- **Nicotine**, poisoning by, I. 533
- **Night terrors**, II. 1036-1037
  - in the young, prevention of, I. 55
- **Nipples**, affections of, II. 977-978
  - areola abscess of, II. 977
  - care of, in pregnancy, IV. 8
  - cracks of, prevention of, II. 977
  - depressed, in the puerperium, IV. 332
  - fissures of, II. 977
  - management of, in pregnancy, IV. 330
  - Paget's disease of, II. 978
  - sore, in the puerperium, IV. 333
- **Nitrate**, *see* Silver, nitrate of
- **Nitre**, sweet spirits of, in diseases of the heart, I, 1224
- **Nitrites** in arterio-sclerosis, I. 1293
  - in chronic polycythemia, II. 85
  - in diseases of the heart, I. 1223
- **Nitrobenzene**, poisoning by, I. 533
- **Nitrogen** apparatus in artificial pneumothorax, I. 1166
- **Nitrogenous** food, value of, I. 451
- **Nitro-glycerine** in eclampsia, IV. 37
  - in gouty angina pectoris, I. 443
- **Nitrous** oxide as anæsthetic, III. 2
  - preceded by ether as anæsthetic, III. 11
  - gas, apparatus for administration of, III. 3
    - steps of the administration of, III. 3
- **Nodal** fever, I. 212-213
  - rhythm in diseases of the heart, I. 1231
- **Noise** in sick room, avoidance of, I. 26
- **Noma**, II. 124-125
  - and cancrum oris, gangrenous, I. 219
  - of the auricle, III. 882
  - of the vulva, IV. 508
- **Noorden's (Von)** treatment of œdema, I. 422
- **Norwood** treatment of alcoholism, I. 501
- **Nose**, accessory sinuses of, diseases of, III. 716-731
  - benign growths of, III. 692
  - bridge of, depression, III. 673
  - care of, in children, I. 49
  - cough in pulmonary tuberculosis, I. 1145
  - deformity of, injection of paraffin wax in, III. 674
  - destruction of parts of, III. 675
  - diseases of, III. 664-666
  - epistaxis from, III. 664-666
- **Nose** (*contd.*)—
  - examination of, in epilepsy, II. 991
  - external malformation of, III. 673
  - foreign bodies in, III. 667
  - hygiene of in typhoid fever, I. 356
  - immediate arrest of bleeding from, in epistaxis, III. 666
  - injection of paraffin wax in, III. 674
  - intranasal malformation of, III. 672
  - irritation of, III. 691
  - lateral deflection of, III. 673
  - leprosy of, III. 780
  - maggots in, III. 669
  - malformations of, III. 671-677
  - malignant growths of, III. 694
    - curative treatment, III. 695
    - located anteriorly in, III. 695
    - small size, III. 695
  - neurosis of, III. 689
    - intranasal treatment, III. 691
  - new growths of, III. 692-698
  - obstruction of, III. 691
  - occlusion of the choana of, III. 672
  - operations on, and anæsthetics, III. 26
  - packing of, in chronic rhinitis, III. 708
  - permanent arrest of bleeding from, III. 666
  - polypi of, III. 691
  - powdered pollantin serum for, III. 287
  - rhinitis anterior sicca of, III. 665
  - rhinoleths of, III. 669
  - stenosis of the anterior nares of, III. 672
  - synechiæ of, III. 672
  - syphilis of, III. 714-715
    - general treatment of, III. 714
    - local treatment of, III. 714
  - wounds of, III. 671-677
- **Nostril** in harelip, II. 90
- **Novocaine**, injection of, for spinal analgesia, III. 37
- **Nuchal** position of the arm, in breech presentation of labour, IV. 132
- **Nuck**, canal of, hydrocele of, IV. 512
- **Nuclein** in boils, III. 1008
- **Nulliparæ**, chronic endo-cervical catarrh in, IV. 566
- **Nursery**, fittings and furniture for, I. 45
  - hygiene of the, I. 44
  - sanitary arrangements for, I. 45
- **Nurses**, cookery to be undertaken by, I. 42
  - directions to, in gynæcological operations, IV. 485
  - duties of, rules for, I. 26
- **Nursing** in acute disease, I. 19
  - in chorea, II. 1262
  - in plague, III. 403
  - in puerperal sepsis, IV. 313
  - of enteric fever, I. 40
  - of infectious cases, I. 41
- **Nussbaum's** bracelet on writer's cramp, II. 1265
- **Nutrient** enemata, I. 32

ion, disorders of, in children, causes , I. 63
values and, I. 450
ıfants and children, I. 46
chemical composition of, II. 197
omica in constipation in adults, II.

gmus, II, 1140-1141
ocular muscles, III. 648
l-nodding in, II. 1141
zontal, II. 1140
lisease of central nervous system, II. 140
niners, II. 1140

rchard Springs, acid baths of, III. 137
sal cure of diabetes, I. 422
ıtment of diabetes, I. 421
t's solution for local analgesia, III.

ty, anæmic, I. 468, 472
nate for, III. 92
t in, II. 212
betic treatment of, I. 470
ıgs in, I. 470
rcises in, I. 469
ndular relations of, I. 473
neral waters and baths in, III. 140
linary, I. 468
t contra-indicated in, I. 470
retory, I. 468, 472
tic, I. 468, 472
getables, suitable in, I. 472
getarian, system in, I. 471
rtheim's operation in, IV. 605
ssive ideas, II. 1313-1314
stric operations, IV. 373-374
neral considerations in, IV. 373
paration of instruments in, IV. 374
of operator in, IV. 373
of patient in, IV. 373
strical bag in management of normal oour, IV. 93
rators, treatment of cleft palate by, . 152
pital neuralgia, II. 1120
pito-posterior presentation in labour, . 144-146
.pation dermatitis, III. 1029
.pations, diseases resulting from, I. 5
cidence of cancer and, I. 117
ıd poisoning, I. 514
uroses of, II. 1264
hammerman's cramp in, II. 1267
telegraphist's cramp in, II. 1266
writer's cramp in, II. 1264
ıtoma, III. 1194
ıtomes, epithelial, of the jaws, II. 112
dicular, II. 110
wyer's bronchial instrument, III. 804
's truss for inguinal hernia, II. 527
ma, angioneurotic, II. 1228-1229; III. 1154-1156
terio-sclerosis, I. 1294

Œdema (*contd.*)—
cerebral, in injuries of the head, I. 884
in fractures, I. 578
of the larynx, III. 858-860
of legs in chlorosis, II. 31
of lungs, I. 1080
of prepuce complicating gonorrhœa, I. 225
of uvula, III. 745
theophyllin in, I. 422
Œsophageal bougie, black elastic, II. 172
conical-ended black, II. 172
silk web, II. 172, 173
feeding, method of, I. 33
Œsophagoscope, Bruning's, for foreign bodies in the œsophagus, II. 187
Œsophagotomy, cervical, for foreign bodies in the œsophagus, II. 186
Œsophagus, burns of, II. 188
cancer of, regurgitation, I. 138
relief of obstruction in, I. 139, 140
diseases of, II. 171-189
diverticular of, II. 189
forceps for removal of foreign bodies in, II. 184-185
foreign bodies in, II. 184-189
Bruning's œsophagoscope for, II. 187
gastrotomy for, II. 186
injuries of, II. 171-189
malformations of, 189
malignant stricture of, II. 175
after treatment in, II. 183
Frank's operation for, II. 177
gastrostomy for, II. 176
methods in, II. 183
Senn's method for, II. 180
Witzel's method for, II. 182
simple stricture of, II. 171-183
stricture of, continuous dilatation in, II. 174
dilatation of, II. 171
intermittent dilatation of, II. 171
medicinal treatment of, II. 171
operative treatment in, II. 174
spasmodic, II. 175
surgical treatment of, II. 171
treatment by tubes, II. 175
ulcers of complicating typhoid fever, I. 357
wounds of, II. 188
in cut throat, II. 165
Oeynhausen spa, III. 154
Ogle (Cyril), diseases of the pericardium, I. 1179-1187
inflammatory conditions of mediastinum, I. 1176
new growth in the mediastinum, I. 1178
Oil diet in duodenal ulcer, II. 211
dressings in burns and scalds, I. 541-548
inunction of, I. 70
See also Castor oil, Olive oil.
Ointments for acne vulgaris, III. 986
for eczema vulvæ, IV. 530
in herpes zoster, II. 1096
inunction of, I. 70

Olecranon, fracture of, I. 596-686
Oligo-hydramnios complicating pregnancy, IV. 44
Olive oil enema, I. 32
  injections of, in constipation in adults, II. 456
Oliver (Thomas), arsenical poisoning, I. 503-504
  auto-intoxication, I. 386-390
  electrical injuries and burns, I. 547-549
  lead poisoning, I. 512-515
  phosphorus poisoning, I. 525
Oliver on arterio-sclerosis, I. 1294
Oliver's alcoholic instrument for test of blood pressure, I. 1281
Omentum, wounds of, II. 253
Onanitic prostatitis, II. 927
Onions in dietary of children, I. 59
Onyalai, III. 469
Onychia, III. 1082
Onychitis, syphilitic, III. 1082
  tuberculous, III. 1082
Oöphorectomy in dysmenorrhœa, IV. 749
  in mammary cancer, I. 150
  in menorrhagia, IV. 763
  in metrorrhagia, IV. 763
Open-air, exercise in, for children, I. 52
  methods in inoperable cancer, I. 133
  treatment in medical climatology, III. 76
Operating table, description of, I. 28
  fittings and preparation of, I. 71
Operation, available, for varicocele, I. 1325
  outfit for, I. 28
  preparation of patient for, I. 27
  room, preparation of, I. 71
Operations, Ball's (Sir Charles), for pruritus ani, II. 597
  Beyea's, for gastroptosis, II. 324
  Carden's, I. 862
  Cheyne's, for malformation of the nose, III. 674
  Estlander's, I. 1107
  Eve's, for gastroptosis, II. 323
  Frank's, for malignant stricture of the œsophagus, II. 177
  Gaillard Thomas's, for fibro-adenomata of the breast, II. 956
  Gleason's, on the nasal septum, III. 681
  Gritti's, I. 862
  gynæcological, IV. 474-486
    after-treatment in, IV. 487-497
    post operative complications, IV. 487-497
  Halsted's for inguinal hernia, II. 507
  in pregnancy, IV. 58
  in varicocele, I. 1324
  Jordan's, I. 868
  Krause's, for pruritus ani, II. 597
  Loreta's, for hypertrophic stenosis of the pylorus, II. 339, 342
  Lotheissen's, for femoral hernia, II. 511
  McEwen's, for inguinal hernia, II. 507
  Mayo's, for umbilical hernia, II. 513
  Miller's, I. 861
Operations (*contd.*)—
  Moure's, on the nasal septum, III. 681
  Mules', for enucleation of the eyeball. III. 660
  Nicoll's, for inguinal hernia, II. 511
  obstetric, IV. 373-374
  Paul's, for cancer of the colon, II. 580
  Schwartze's, for opening mastoid antrum, III. 898
  Smith's, for immature cataract, III. 621
  Stephen Smith's, I. 859-861
  surgical, antiseptic precautions during, I. 81
Operator, preparation of, in obstetric operations, IV. 373
Ophthalmia, gonorrhœal, I. 228
  in the adult, III. 555
  neonatorum, III. 553
    in newborn child, IV. 366
Ophthalmitis, sympathetic, III. 598
  curative treatment, III. 600
  prophylaxis of, III. 598
Ophthalmoplegia and migraine, II. 1033
  of ocular muscles, III. 648
Opium habit, combretum sundiacum in, I. 518
  in constipation in adults, II. 446
  in diabetes mellitus, I. 424
  in diseases of the heart, I. 1225
  in epilepsy, II. 998
  in epithelioma of the tongue, II. 144
  in melancholia, II. 1297
  in pericarditis, I. 1180
  in peritonitis, II. 638
  in pruritus, III. 1099
  in smallpox, I. 308
  poisoning by, I. 531
  relief of pain by, I. 134
  use of, in diseases of children, I. 66
Opsonic index, high, vaccine therapy and, I. 208
    in acute tuberculosis, I. 334
Opsonins in serum therapy, III. 259
Optic atrophy, III. 645
  nerve, diseases of, III. 645
  neuritis, III. 645
Oral administration in vaccine therapy, III. 265
  antiseptics in pernicious anæmia, II. 6
  sepsis, II. 127-129
    prophylaxis of, II. 127
Orbit, arterio venous aneurysms of, III. 662
  cellulitis of, III. 661
  diseases of, III. 661-663
  tenonitis of, III. 662
  thrombosis of, III. 662
  tumours of, III. 662
  wounds of, III. 661
Orbital foramen, infra-neuralgia in, II. 1118
  neuralgia, periodic supra, II. 1115
    supra, II. 1115
  notch, supra-neuralgia of, II. 1117

is, acute, II. 906
plicating mumps, I. 257
ial, III. 503
ine therapy of, III. 281
otherapy in cancer, I. 149
pilepsy, II. 999
terility, IV. 854
lague, III. 409
tal sore, III. 454-456
eral treatment of, III. 454
harynx, benign growths of, III. 784
ignant growths of, III. 785
growths of, III. 784-785
an in syphilis, I. 321
pædic measures in arthritis defor-
ans, I. 397
steo-arthritis, I. 403
pædics, physical exercises in, III. 233
lcis, fracture of, I. 632
ertrophy of, III. 465
erculosis of, I. 773
eri, dilatation of, in normal labour,
. 103
(**Sir W.**) on Banti's disease, II. 82
ulectomy in chronic inflammation of
middle ear, III. 913
tis after amputations, I. 804
ormans, II. 1237
erculous, of the skull, I. 889
-**arthritis**, chronic rheumatism and,
. 483
nplicating pregnancy, IV. 57
t in, I. 400
al treatment of, I. 402
ssage in, I. 402
dicinal treatment of, I. 401
temporo-maxillary joint, II. 105
hopædic measures in, I. 403
arthropathy, pulmonary, hyper-
phic, II. 1233
genesis imperfecta, II. 1237
ma of the jaw, II. 109
the scalp, I. 893
malacia complicating pregnancy,
712 ; IV. 58
malacic pelvis complicating labour,
. 172
myelitis, acute, in infective lesions
of the skull, I. 889
of the spine, I. 916-917
er amputations, I. 804
the thoracic wall, I. 1032
ppurative, I. 696, 698
umatic in injected lesions of the
skull, I. 889
o-periosteal method of amputation,
801
tomy in ankylosis, I. 764
rachitic deformities, I. 972
gia of the meatus, III. 884
s externa circumscripta of the
meatus, III. 885
oupous, of the meatus, III. 884
ffusa of the meatus, III. 886
edia, III. 894-903

Otitis (*contd.*)—
catarrhal, chronic, and Eustachian obstruction, III. 944
chronic, III. 904
complicating diphtheria, I. 202
meningitis, I. 252
scarlet fever, I. 289
purulent, III. 904
pyogenic, III. 904
Oto-fibrosis and Eustachian obstruction, III. 944
Otomasseur, Delstanche's, III. 952
Otomycosis of the meatus, III. 886
Otorrhœa in measles, I. 246
in scarlet fever, I. 282, 289
Otosclerosis, III. 954-957
deafness in, III. 956
general treatment of, III. 954
local treatment of, III. 955
symptomatic treatment of, III. 995
Ovarian dermoids, I. 110.
Ovaries, abscess of, IV. 765
care of, in ovariotomy, IV. 779
cysts of, suppurating, IV. 797-798
tapping of, in ovariotomy, IV. 782
diseases of, IV. 765-798
mineral waters and baths in, III. 145
sterility in, IV. 846
hernia of, IV. 767
metabolic disorder and, I. 389
pain in, chronic, IV. 766
prolapse of, IV. 796
removal of, in dysmenorrhœa, IV. 746
in uterine fibroids, IV. 639
tumours of, Cæsarean section in, IV. 384
during labour, IV. 773-774
during pregnancy, IV. 771-772
during puerperium, IV. 774
malignant, IV. 770
Ovariotomy, IV. 775-795
adhesions in, IV. 780
after-treatment of, IV. 789
care of other ovary in, IV. 779
drainage in, IV. 785
dressing in, IV. 788
hæmorrhage after, IV. 793
hiccough after, IV. 792
in pregnancy, IV. 771
injury to intestine in, IV. 785
instruments for, IV. 776
ligatures in, IV. 776
of pedicle in, IV. 783
operation of, IV. 777
peritonitis after, IV. 794
preparation of patient, IV. 775
shock after, IV. 793
sutures in, IV. 776
of abdominal wall in, IV. 787
tapping the cyst in, IV. 782
thrombosis after, IV. 794
vaginal, IV. 795
vomiting after, IV. 791
Overstrain in the menopause, IV. 503
mineral waters and baths in, III. 146

- **Ovum** forceps for retained placenta, IV. 226
- **Oxalic** acid in foodstuffs, II. 744
  - poisoning by, treatment of, I. 528
- **Oxaluria**, II. 742
- **Oxybutyne** (B.), acid in the urine, I. 417
- **Oxygen** in acute bronchitis, I. 1051
  - in asthma, I. 1040
  - in diseases of the heart, I. 1225
  - in eclampsia, IV. 37
  - in hæmorrhage, I. 1267
  - in poisoning, I. 528, 531, 533, 535
  - inhalations in pernicious anæmia, II. 9
    - in pneumonia, I. 245, 261
- **Oxymel** of squill in laryngitis, I. 245
- **Oxyuriasis**, III. 495
  - prophylaxis of, III. 493

- **Pachydermia** laryngis, III. 850
- **Pachymeningitis**, I. 905
- **Packs**, use of, I. 37, 38
- **Paget's** disease, II. 1237
  - of the nipples, II. 978
  - recurrent fibroid, I. 114
- **Pain**, abdominal, complicating typhoid fever, I. 359
    - relief of, I. 513
  - after abdominal operations, II. 263
  - after cataract extraction, III. 632
  - as symptom of cancer of cervix, IV. 585
  - complicating gynæcological surgery, IV. 490
    - tuberculous peritonitis, II. 646
    - ulcer of the stomach, II. 380
  - in aortic aneurysm, I. 1299
  - in ascites, II. 627
  - in cancer, relief of, I. 133, 134
    - of cervix, IV. 617
    - of the stomach, II. 299
  - in chronic nephritis, II. 799
  - in disordered digestion in the stomach, II. 373
  - in gunshot wounds, I. 558
  - in hæmorrhoids, II. 617
  - in hemiplegia, II. 1188
  - in herpes zoster, III. 1043
  - in labour, IV. 103
  - in lead poisoning, I. 512
  - in myelitis, II. 1215
  - in non-operative appendicitis, II. 423
  - in normal puerperium, IV. 264
  - in secretory disorders of the stomach, II. 363
  - in uterine fibroids, IV. 638
  - in varicose veins, IV. 89
  - opium in, I. 67
  - ovarium, chronic, IV. 766
  - pre-cordial, complicating acute endocarditis, I. 1193
  - rectal, II. 614
  - relief of, by injection of alcohol into nerve trunks, I. 135
    - in pleurisy, I. 1094
  - severe, in chronic dilatation of the stomach, II. 314
- **Paints** for herpes zoster, II. 1096
- **Palate**, cleft, II. 147-156
    - after-treatment in, operations for, II. 151
    - anæsthetic in operation for, II. 149, III. 28
    - Brophy's operation in, II. 149
    - gag in operation for, II. 150
    - hæmorrhage in operation for, II. 150
    - in newborn child, IV. 357
    - operation for, II. 149
    - operative treatment of, II. 147
  - treatment of by obturators, II. 152
  - spasmodic affections of, and neuroses of pharynx, III. 783
- **Palatine** arteries, hæmorrhage from, I. 1275
- **Palliative** treatment, I. 18
  - of inoperable cancer, I. 131
- **Palmar** arteries, wounds of, I. 1276
- **Palpation** in normal labour, IV. 97, 98
- **Palpitation** in angina pectoris, I. 1252
- **Palsy**, atrophic flaccid, in myelitis, II. 1217
  - brachial, in newborn child, IV. 365
  - bulbar, II. 1061
  - cerebral, of infants, II. 1153-1156
    - surgical treatment of, II. 1157-1164
  - craft, II. 1267
  - facial, in newborn child, IV. 365
    - *See also* Paralysis.
- **Pancreas**, abscess of, II. 720
  - calculi of, II. 724-725
    - pancreo-lithotomy in, II. 724
  - cancer of, II. 729
  - cysts of, II. 726-728
    - statistics, II. 727
  - diseases of, II. 716-729
  - enlargement of and cholelithiasis, II. 694
  - inflammation of, II. 717
  - parenchymatous inflammations of, acute, 717
  - wounds of, II. 716-729
- **Pancreatitis**, acute, II. 718-719
  - chronic, II. 723
  - subacute, II. 720-722
- **Pancreo-lithotomy** in pancreatic calculi, II. 724
- **Panhysterectomy** of the uterus, IV. 401
- **Panse's** flap in operation for diseases of mastoid process, III. 924, 925
- **Pansini** on influence of red and blue light, III. 194
- **Panticosa** spa, III. 154
- **Papilloma**, duct, of the breast, II. 954
  - of Fallopian tube, IV. 816
  - single, of the bladder, II. 870
- **Papillomata** of lingual tonsil, III. 762
  - of the meatus, III. 883
  - of the penis, II. 878
  - multiple of bladder, II. 871
    - of the larynx in children, III. 851
- **Paracentesis** of anterior chamber of ciliary-body, III. 593

entesis (*contd.*)—
scites, II. 628
nflammations of middle ear, III. 895, 04, 905
ericarditis, I. 1182
hod of, in hydrothorax, I. 1091
icardii, I. 1188
hnique of, in acute inflammation of he middle ear, III. 895
retinoid lipomatosis, I. 108
sthesia of the pharynx, III. 782
fin eczema, I. 117
kin eruptions, I. 446
ctions in chronic rhinitis, III. 709
id, in constipation in adults, II. 451
x. injection of, in nose, III. 674
dehyde in insomnia, II. 1023
ysis, acute nuclear, of ocular muscles, II. 649
ociated with labour, IV. 280
with the puerperium, IV. 281
chial birth, II. 1012, 1110
nplete recurrent, of vocal cords, III. 44
nplicating pregnancy, IV. 60
htheritic, forms of, I. 200
lopic, of ocular muscles, III. 649
ers, I. 1306
e to spinal injury, I. 899
ial, II. 1093-1095
  electricity in, II. 1094
  massage in, II. 1094
  nerve anastomosis in, II. 1109
  nerve crossing in, II. 1109
mily periodic, II. 1247
ccid, in paraplegia, II. 1197
llowing anæsthesia, III. 35
nctional, hypnotism in case of, III. 171
neral, of the insane, II, 1077
  anti-syphilitic treatment in, II. 1078
  congestive attacks, II. 1079
  constipation in, II. 1079
  excitement in, II. 1079
  irritability in, II. 1079
  late stages of, II. 1086
  refusal of food in, II. 1079
  serum therapy of, II. 1079
  surgery of, II. 1079
  symptomatic treatment, II. 1079
morrhagic, of ocular muscles, III. 648
hemiplegia, II. 1184
lead poisoning, I. 513
neuritis, prevention of deformity from, II. 1034
spina bifida, I. 916
fantile, nerve anastomosis in, II. 1059-1060
audry's, II. 1080
ittle's, in infants, I. 886
igrainous recurrent, of ocular muscles, III. 649
f muscles of the larynx, III. 842
f inter-arytenoideus muscle, III. 844

Paralysis (*contd.*)—
  of pharynx, III. 782
  of thyro-arytenoidei interni tensors of the vocal cords, III. 843
  of ulnar nerve, II. 1267
  post-diphtheritic, of ocular muscles, III. 649
  prevention of bedsores in, I. 31
    deformity in, in neuritis, II. 1132
  rheumatic, of ocular muscles, III. 649
  spastic, in paraplegia, II, 1197
  spinal, deformities due to, I. 988-990
  syphilitic, II. 1069
  thrombotic, of ocular muscles, III. 648
Paralysis agitans, II. 1269-1270
    drugs in, II. 1270
Paralytic deformities of the upper limb, I. 990
  distension complicating abdominal operations, II. 271
  torticollis, II. 1051
Parametritis, chronic, in pelvic cellulitis, IV. 834
  remote, in pelvic cellulitis, IV. 833
Paramyoclonus multiplex, II. 1255-1256
Paranoia, II. 1309
Paraphimosis of the penis, II. 879
Paraplegia, II. 1195-1199
  bedsores in, II. 1199
  electricity in, II. 1198
  endogenous, II. 1196
  exogenous, II. 1196
  flaccid paralysis in, II. 1197
  genito-urinary symptoms in, II. 1199
  hereditary spastic, II. 1249
  in severe injuries of the spine, I. 906
  in tuberculous disease of the spine, I. 926-927
  massage in, II. 1198
  of cerebral causation, II. 1195
  of cerebro-spinal origin, II. 1196
  of spinal origin, II. 1196
  rectum symptoms in, II. 1199
  spastic paralysis in, II. 1197
Parapsoriasis, III. 1084
Parasites, certain diseases caused by, III. 487
  intestinal and anæmia, II. 15
  of the stomach, II. 359
Pardoe (John), diseases and affections of the prostate gland, II. 918-929
  diseases and affections of the tunica vaginalis, II. 913-929
  fibroma of the prostate, II. 950-951
  tumours of the prostate, II. 930-949
Parenchymatous cells, embolism by, I. 1306
  goitre, II. 63, 67
  hæmorrhage, I. 1272
Parker's tracheotomy tubes, use of, I. 196
Parotid gland, inflammation of, II, 157-163
    dry mouth and, II. 163
    ptyalism and, II. 161

Parotid gland (*contd.*)—
ranula cyst and, II. 158
salivary calculi and, II. 159
salivary fistula and, II. 160
salivation and, II. 161
xerostomia and, II. 163
tumours of, II. 161
innocent, operation for, II. 161
malignant, operation for, II. 162
wounds of, II. 162
Parotitis, I. 256-257
complicating gynæcological surgery, IV. 495
typhoid fever, I. 357
secondary, II. 158
simple, II. 157
symptomatic, II. 131, 158
Partsch's metal band for fracture of the jaws, II. 114
Parturition. *See* Labour *and* Puerperium.
Pasteur (W.) on active collapse of the lung, I. 1065
Pasteurisation of milk, II. 220
Pasteur's inoculation method of treatment of rabies, I. 264
Patella, dislocations of, I. 728
fractures of, I. 620-622, 679
Paterson (D. R.), actinomycosis of the pharynx, III. 765
chronic hyperplasia of the mucous membrane of the upper respiratory tract, III. 774
glanders, III. 670
gout affections of the throat, III. 775
hypertrophy of the pharyngeal tonsil, III. 732-738
keratosis of the pharynx, III. 779
naso-pharyngeal catarrh, III. 739-741
pharyngomycosis, III. 787
rheumatic affections of the throat, III. 764
rhinoscleroma, III. 713
thrush, III. 792
Paterson (Marcus). The treatment of pulmonary tuberculosis by graduated labour, I. 1159-1163
Paterson's electric-heated infusion apparatus, I. 100
forceps, III. 849
Pathology, recuperative factors in, I. 10, 11
Patient, care of, in typhoid fever, I. 338
final directions to, after abdominal operations, II. 268
general health of, in abdominal operations, II. 257
general management, I. 9
individuality of, I. 25
position of, in gynæcological surgery, IV. 487
preparation of, for operation, I. 27, 83
in abdominal operations, II. 257; IV. 485
in Cæsarean section, IV. 385
in obstetric operations, IV. 373
Patient, preparation of (*contd.*)—
in shock, I. 95
in vaginal operations, IV. 484
protection of, in X-ray treatment, III. 345
Patients after abdominal operation, treatment of, II, 262
Paul's operation for cancer of the colon, II. 580, 584
Pavy's method of estimation of sugar, I. 420
Pawlik's grip in palpation in normal labour, IV. 100, 101
Pawlow on food values, I. 449
Pearson (S. V.) and **Claude Willington.** The treatment of pulmonary tuberculosis by the induction of an artificial pneumothorax, I. 1164-1173
Peat baths, III. 135
in arthritis deformans, I. 398
Pedicle needle in laceration of the genital tract, IV. 192
Pediculosis, III. 1086-1087
capitis, III. 1086
in anæmia, II. 14
corporis, III. 1086
pubis, III. 1087
Pellagra, I. 521-524
advanced cases of, I. 521
blood transfusion in, I. 523
diarrhœa in, I. 522
drugs in, I. 522
lunacy of, I. 523
Pelvi-rectal abscess of the anus, II. 604
Pelvic cellulitis, IV. 824-838
abscess cavities in, drainage of, IV. 848
anti-streptococcus serum in, IV. 833
in diseases of pelvic bones, IV. 836
inflammation virulent in, IV. 831
moderate acute infection in, IV. 827
parametritis, chronic in, IV. 834
remote in, IV. 833
summary of treatment, IV. 837
suppuration in, IV. 828
treatment of, IV. 826
vaccine treatment of, IV. 837
grip in palpation in normal labour, IV. 101, 102
lifting exercise in heart disease, III. 253
Pelvis, bones of, pelvic cellulitis in, IV. 836
bony, hydronephrosis due to obstruction in, II. 772
cellular tissue of, drainage of in puerperal sepsis, IV. 306
contractions of, Cæsarean operation in, table of mortality, IV. 402
Cæsarean section in, IV. 383
complicating labour, IV. 163-175
Cæsarean section in, IV. 170
cleidotomy in, IV. 171
hebosteotomy in, IV. 171
pubiotomy in, IV. 171
symphysiotomy in, IV. 1171

- **Pelvis**, contractions of (*contd.*)—
    - decapitation in, IV. 415
    - diet in, in labour, IV. 174
    - induction of premature labour in, IV. 434
    - rare, complicating labour, IV. 172-175
  - deformities of, symphysiotomy for, IV. 454
  - drainage of, by vaginal incision in puerperal sepsis, IV. 302
  - examination of, in sterility, IV. 851
  - exostosis of, complicating labour, IV. 174
  - flat, complicating labour, IV. 168
  - flattened, podalic version in, IV. 466
  - floor of, rigidity of, forceps in, IV. 420
  - fracture of, I. 605
    - in abdominal injuries, II. 249
  - infective processes in, subinvolution of uterus by, IV. 723
  - kyphotic, complicating labour, IV. 173
  - malacosteon, complicating labour, IV. 172
  - maternal, disproportion between child and, forceps in, IV. 417
    - position of blades of forceps to, IV. 431
  - oblique, complicating labour, IV. 173
  - organs of, in normal puerperium, IV. 257
  - osteomalacic, complicating labour, IV. 172
  - pseudo - osteomalacic, complicating labour, IV. 172
  - Robert's, complicating labour, IV. 173
  - spondylolisthetic, complicating labour, IV. 173
- **Pemphigus**, III. 1088-1089
  - acute, III. 1088
  - chronic, III. 1088
  - contagiosus, III. 474
  - foliaceus, III. 1089
  - of the pharynx, III. 788
  - vegetans, III. 1089
- **Pendlebury (H. S.)**, caseating tuberculous glands in the mediastina, I. 1177
  - inflammation of the ribs and sternum, I. 1032-1033
  - inflammatory conditions of mediastinum, surgical treatment of, I. 1176
  - injuries of the chest, I. 1031
  - new growths of the thoracic wall, I. 1034
  - surgical treatment of abscess of the lung, I. 1060-1062
  - surgical treatment of growths of the lung, I. 1175
  - surgical treatment of hydrocephalus, II. 1193
  - surgical treatment of pericarditis, I. 1188-1189
  - surgical treatment of purulent pleural effusion, I. 1101-1109
  - surgical treatment of pyopneumothorax, I. 1114
- **Penis**, bruises of, II. 876
  - cancer of, relief of obstruction in, I. 142
  - chordee and painful erections of, complicating gonorrhœa, I. 226
  - diseases of, II. 874
  - dressing of, in operation for elephantiasis scrote, III. 513
  - flaps to, in operation for elephantiasis scrote, III. 511
  - grafting of in operation for elephantiasis scrote, III. 511
  - injuries of, II. 876
  - lacerations of, II. 876
  - malformations of, congenital, II. 875-876
  - malignant disease of, II. 877
  - papillomata of, II. 878
  - paraphimosis of, II. 879
  - phimosis of, II. 879
  - rupture of frænal artery of, II. 876
  - sloughing of, I. 316
- **Pepsin**, effect on gastric function, II. 291
- **Peptonised** beef-tea, preparation of, I. 42
  - milk, II. 226
    - preparation of, I. 42
- **Peptonuria**, II. 733
- **Perambulators** for young children, use of, I. 52
- **Perchloride** of mercury, in lotions, I. 73
  - solution, strength of, I. 81
- **Pericardial** adhesions, I. 1189
- **Pericarditis**, I. 1179
  - chronic, mediastinal, and adherent pericardium, I. 1186
  - complications of, I. 1179
  - drugs in, I. 1180
  - in acute rheumatism, I. 272, 278
  - in rheumatism, I. 1179
    - in childhood, I. 278
  - pneumococcus, infection with, I. 1182
  - purulent, I. 1184
  - surgical treatment of, I. 1188-1189
  - tuberculous, I. 1184
  - with kidney disease, I. 1185
- **Pericardium**, adherent, and chronic mediastino-pericarditis, I. 1186
  - diseases of, I. 1179-1187
    - operation and drainage in, I. 1183
  - drainage of, I. 1188
  - injuries of, I. 1030
- **Perichondritis** of the auricle, III. 881
  - of the larynx, III. 861-862
- **Pericolitis**, II. 574
  - general peritonitis in, II. 576
  - localised abscess in, II. 575
  - perforation in, II. 576
- **Perigastritis**, complicating hour-glass stomach, II. 336
- **Perineal** dressing in operation for elephantiasis scroti, III. 513
- **Perineorraphy**, IV. 549
- **Perinephritic** abscess, II. 801-802
  - results of operation for, II. 801
- **Perineum**, blow on, injuries of the urethra by, II. 882

- **Perineum** (*contd.*)—
  - examination of, in labour, IV. 126
  - falls on, injuries of urethra by, II. 882
  - laceration of, complicating labour, IV. 204
  - pedunculated fibromata of, I. 112
  - rupture of, treatment, IV. 208
  - support of, in second stage of labour, IV. 113
  - threatened rupture of, forceps in, IV. 420
- **Perineal** muscular atrophy, II. 1253
- **Periodontal** membrane, diseases of, III. 1174
- **Periodontitis** suppurative, chronic, III. 1176
- **Periosteal** flaps, I. 800
- **Periosteum**, treatment of, in amputations, I. 800
- **Periostitis**, acute, I. 694
  - in infective lesions of the skull, I. 889
  - non-suppurative, I. 694, 703
  - of the spine, I. 916-917
- **Peritoneal** infusion in shock, I. 101
  - toilet in perforation of the intestine, II. 554
- **Peritoneum**, adhesions of, division of, in constipation in adults, II. 467
  - contained in lipomata, I. 107
  - diseases of, II. 626-642
  - fistulæ of, II. 280
- **Peritonitis**, II. 632-642
  - abdominal distension in, II. 638
  - acute, table of cases of, at St. Thomas' Hospital, II. 633
  - administration of fluids per rectum in, II. 635
  - after ovariotomy, IV. 794
  - artificial leucocytosis in, II. 637
  - colon bacillus, II. 641
  - complicating gynæcological surgery, IV. 492
    - typhoid fever, I. 359
  - diffuse, in appendicitis, II. 422
  - feeding in, II. 640
  - general, and appendicitis, II. 405
    - in appendicitis, II. 422
    - in pericolitis, II. 576
  - gonorrhœal, II. 642
  - hiccough in, II. 639
  - in abdominal injuries, II. 244
  - in gunshot wounds, I. 566
  - incision in operation for, II. 634
  - morphia in, II. 639
  - operation for, II. 633
  - opium in, II. 638
  - pneumococcal, II. 641
  - proctoclysis in, II. 635
  - purgatives in, II. 638
  - repeated sickness in, II. 638
  - rules before operation, II. 633
  - serum treatment of, II. 637
  - special forms of, II. 641-642
  - staphylococcic, II. 641
- **Peritonitis** (*contd.*)—
  - stimulants in, II. 638
  - streptococcic, II. 641
  - tuberculous, II. 645-647
    - appendix and, II. 411
    - complications of, II. 645
    - general measures in, II. 645
    - medicinal measures in, II. 645
    - removal of ascetic fluid in, II. 647
    - tuberculin in, II. 646
  - vaccine treatment of, II. 637
- **Peri-urethral** abscess, II. 895-896
  - complicating gonorrhœa, I. 226
- **Perkins** (J. J.), abscess of the lung, I. 1059
  - gangrene of the lung, I. 1059
  - hæmothorax, I. 1090
  - hydrothorax, I. 1091-1092
  - pneumothorax, I. 1112-1113
  - pyopneumothorax, I. 1113
- **Perlsucht** tuberculin, III. 294
- **Permanganate**, potassium in gastric lavage, I. 528, 531
- **Peroxide** of hydrogen as a hæmostatic, I. 138
  - of iron, hydrated in arsenical poisoning, I. 504
- **Persuasion** method in hysteria, II. 1012
- **Perversions**, II. 1315
- **Pes** arcuatus, I. 963
  - cavus, I. 963
- **Pessaries** in prolapse of uterus, IV. 690-692
  - mechanical treatment of retroflexion of uterus, IV. 678, 680
- **Petrissage** and massage, III. 204
- **Phagedæna** in syphilis, I. 316
  - tropical, III. 472
- **Phagedænic** ulcers, I. 369
- **Phagocytosis**, invigoration of, I. 7, 11
- **Phalanges**, fracture of, I. 605
  - of the thumb, congenital lateral deviation of, I. 938
- **Phalanx**, middle, amputation through, I. 806
- **Pharyngeal** fibromata, I. 113
  - tonsil diseases of, III. 732-738
- **Pharyngitis**, acute catarrhal, III. 766-767
  - chronic catarrhal, III. 767-769
  - complicating influenza, I. 239
- **Pharyngo-keratosis** of lingual tonsil, III. 762
- **Pharyngomycosis**, III. 787
- **Pharynx**, actinomycosis of, III. 765
  - acute septic inflammation of, III. 772
  - anæsthesia of, III. 782
  - and voice production, III. 335
  - cancer of, relief of obstruction in, I. 139
  - diseases of, III. 765-783
  - hæmorrhage from, III. 776-777
  - herpes of, III, 778
  - hyperæsthesia of, III. 782
  - keratosis of, III. 779
  - leprosy of, III. 780
  - lupus of, III. 781

ıx (*contd.*)—
gnant growths of, III. 786
osis of, III. 787
diseases of, III. 732-743
algia of, III. 782
oses of, III. 782-783
otion of, III. 782
nsation of, III. 782
growths of, III. 699-700
esthesia of, III. 782
lyses of, III. 782
phigus of, III. 788
modic affections of the palate, III. 3
ilis of, III. 791-792
rculosis of, III. 793-794
ration of, III. 795-796
nds of, in cut throat, II. 165
cetin for relief of pain, I. 134
nfluenza, I. 233
oning by, I. 533
zone in diabetes insipidus, I. 429
hooping cough, I. 382
l, poisoning by, I. 527
sis in the newborn child, IV. 360
he penis, II. 879
itis and thrombosis, I. 1328-1338
ty, I. 1330
gout and gouty conditions, I. 444
aricose veins, IV. 89
-infective, I. 1328
tic cases of, I. 1329
ple, I. 1328
hilitic, I. 1330
otomus fever, III. 400
masia alba dolens in puerperal sis, IV. 321
monous gastritis, II. 353
tenular conjunctivitis, III. 552
eration of the cornea, III. 567
haturia, II. 746
horetted hydrogen, poisoning by, I.
horus, effect of, on the teeth, II. 08
rickets, I. 480
soning, I. 525
cute, I. 528
phobia in measles, I. 242
isis complicating pregnancy, IV. 9
monary, I. 1117-1126
ical exercises, III. 222-257
thods in hysteria, II. 1012
ostegmine or eserine, poisoning by, 533
a, III. 476
asek on tracheoscopy, III. 805
entations, preceding melanotic ncer, I. 120
, operations for, II. 618
liative treatment, II. 615
ws, arrangement of, I. 30
arpine in eclampsia, IV. 37
isoning by, I. 533

Pinard's registering separator for symphysiotomy, IV. 457
Pinhole os, leucorrhœa in, IV. 567
Pinna, deviated, III. 877
Pinta or caraate, III. 477
Pirogoff's amputation, I. 848
von **Pirquet's** skin reaction in diseases of the pericardium, I. 1185
Pituitary body, influence on obesity, I. 473
  extract in obesity, I. 473
    in pneumonia, I. 261
    infusion in shock, I. 103-5
Pituitous catarrh or bronchorrhœa serosa, I. 1058
Pityriasis rosea, III. 1090-1091
    general treatment of, III. 1090
    local treatment of, III. 1090
  rubra, III. 1093
    pilaris, III. 1092
    gravis of Hebra, III. 1151
  versicolor, III. 1095
Placenta, adherent, complicating labour, IV. 228, 234
    removal of, IV. 234
  examination of, in third stage of labour, IV. 123
  expression of, in third stage of labour, IV. 120, 121
  expulsion of, in third stage of labour, IV. 119
  prævia, Cæsarean section in, IV. 385
    central insertion of de Ribes' bag in, IV. 67, 68
    complicating pregnancy, IV. 65.
    epitome of treatment of, IV. 69
    lateral insertion of de Ribes' bag in, IV. 66, 68
    marginal insertion of de Ribes' bag in, IV. 66, 68
    occurring before labour has begun, IV. 65
    post-partum hæmorrhage in, IV. 68
    syncope in, IV. 69
  removal of, in Cæsarean section, IV. 391
  retention of, complicating labour, IV. 225-237
    in hour-glass contraction of uterus, IV. 230, 231
    in missed abortion, IV. 225
    in third stage of labour, IV. 229
    in uterine atony, IV. 229
  succenturiate, in third stage of labour, IV. 124
Placental extract in cancer, I. 150
Plague, III. 401—409
  antiseptic drugs in, III. 406
  bubo in, III. 405
  carbuncles in, III. 406
  contacts in, III. 402
  convalescence of, III. 406
  diet in, III. 403
  disinfection during illness from, III. 402
  general management of, III. 401

Plague (*contd.*)—
- initial precautions in, III. 401.
- nursing in, III. 403
- organo-therapy of, III. 409
- pneumonic, III. 405
- point of inoculation in, III. 405
- preventive inoculation in, III. 284
  - results, III. 284
- re-inoculation in, III. 284
- serum-therapy of, III. 407
- specific methods of treatment of, III. 406-409
- stimulants in, III. 403
- symptomatic treatment of, III. 404
- ulcer in, III. 406
- vaccine therapy of, III. 284

Plantar neuralgia, I. 964

Plaster of Paris splinting, I. 574
  - splints, I. 628
- splint in tuberculous disease of hip-joint, I. 760

Plasters, application of, I. 36

Plastic operations in ulceration, I. 375

Pleura, wounds of, I. 1027

Pleural cavity, injections into, in pleural effusion, I. 1097

Pleurisy, after-treatment of, I. 1097
- and pleural effusion (sero-fibrinous), I. 1093-1098
- complicating artificial pneumothorax, I. 1170
  - pregnancy, IV. 50
  - pulmonary tuberculosis, I. 1158
- delayed re-expansion of lung in, I. 1098
- physical exercises in, III. 252
- relieved by belladonna plaster, I. 1307
- with effusion and tumours of the lung, I. 1174
  - (purulent), I. 1099-1100
  - surgical treatment of, I. 1101
  - treatment by tapping or aspiration, I. 1095

Plombières spa, III. 154

Plumbism and anæmia, II. 16
- complicating pregnancy, IV. 56
- industrial, prevention of, I. 514

"**Pneumatic** cabinet" in emphysema, I. 1086
- treatment of asthma, I. 1042

Pneumatoceles of the skull, I. 896

Pneumaturia, II. 749

Pneumococcal arthritis, I. 783-784

Pneumococcic vaccine treatment in diseases of the pericardium, I. 1184

Pneumococcus infections, serum therapy of, III. 285
  - in pericarditis, I. 1182
- meningitis, I. 250
- peritonitis, II, 641
- vaccine, dose of, III. 286

Pneumokoniosis, I. 1115

Pneumonia, I. 258-263
- abscess of lung following, I. 1060

Pneumonia (*contd.*)—
- bronchial, I. 1066-1073
  - horse serum in, III. 262
- catarrhal, external applications in, I. 69
- chronic interstitial, I. 1074-1075
  - prophylaxis of, I. 1074
- complicating gynæcological surgery, IV. 494
  - influenza, I. 240
  - typhoid fever, I. 361
- delayed resolution after, III. 252
- drugs in, I. 259-261
- feeding in, I. 258
- glandular extracts in, I. 261
- in injuries of the spine, I. 909
- ice-poultice in, I. 259
- jacket, how to make, I. 34
- lobar, complicating pregnancy, IV. 49
  - in pericarditis, I. 1182
  - in measles, I. 245
- serum treatment of, I. 262
- sleeplessness in, I. 259
- stimulants in, I. 259
- vaccine treatment of, I. 263

Pneumonic plague, III. 405

Pneumothorax, artificial, choice of patient, I. 1171
  - completion and the maintenance of, I. 1168
  - complications of, I. 1171
  - difficulties in the course of the operation, I. 1167
  - duration of treatment, I. 1169
  - dyspepsia complicating, I. 1170
  - Forlanini's method of, I. 1170
  - modifications of method, I. 1170
  - Murphy's method of, I. 1170
  - pleurisy complicating, I. 1170
  - technique of, I. 1165
  - treatment of pulmonary tuberculosis by the induction of, I. 1164-1173
- complicating pregnancy, IV. 50
- in injuries of the thorax, I. 1029

Poisoning, artificial respiration in, I. 530, 532, 534
- by acetanilide, I. 533
- by aconite, I. 532
- by aconitine, I. 532
- by ammonia, I. 527
- by aniline, I. 533
- by antifebrin, I. 533
- by antimony, I. 529
- by antipyrin, I. 533
- by arsenic, I. 529
- by arseniuretted hydrogen, I. 535
- by atropine, I. 532
- by belladonna, I, 532
- by benzene, I. 533
- by calabar bean, I. 533
- by cantharides, I. 532
- by carbolic acid, I. 527
- by carbon dioxide, I. 534
- by carbon monoxide, I. 534
- by carbonic acid, I. 534
- by caustic alkalies, I. 527

Poisoning (*contd.*)—
- by chloral hydrate, I. 530
- by chloroform, I. 531
  - in fatty liver, II. 668
- by cocaine, I. 532
- by colchicine, I. 533
- by colchicum, I. 533
- by digitalis, I. 533
- by ergot, I. 533
- by eserine, I. 533
- by gabarandi, I. 533
- by hellebore, black, I. 533
  - green, I. 533
  - white, I. 533
- by henbane, I. 532
- by hydrocyanic acid, I. 530
- by hyoscine, I. 532
- by hyoscyamine, I. 532
- by laburnum, I. 533
- by mercury, I. 530
- by mineral acids, I. 526
- by morphia, I. 531
  - coma in, II. 984
- by mushroom causing diarrhœa, II. 480
- by nicotine, I. 533
- by nitro-benzene, I. 533
- by opium, I. 531
- by oxalic acid, I. 528
- by phenacetin, I. 533
- by phenol, I. 527
- by phosphoretted hydrogen, I. 535
- by phosphorus, I. 525, 528
- by physostigmine, I. 533
- by pilocarpine, I. 533
- by potassium chlorate, I. 532
- by pyridine, I. 533
- by salts of barium, I. 529
  - of copper, I. 529
  - of lead, I. 529
  - of tin, I. 529
  - of zinc, I. 529
- by savin, I. 533
- by scopolamine, I. 532
- by stramoniun, I. 532
- by sulphonal, I. 531
- by sulphuretted hydrogen, I. 534
- by tetronal, I. 531
- by tobacco, I. 533, 534
- by trional, I. 531
- by turpentine, I. 532
- by vegetable irritants, I. 533
- by veratrine, I. 533
- by veronal, I. 531
- by yew, I. 533
- oxygen in, I. 528, 531, 533, 535
- potassium permanganate in, I. 528, 531
- renal complications in, I. 530, 532

Poisons and antidotes, I. 526-535
- corrosive, I. 526-528
- gaseous, I. 534-535
- irritant, I. 528-530
- narcotic, I. 530-534

Polio-myelitis, acute, anterior, II. 1055-1058
- electricity in, II. 1056

Polio-myelitis, acute, anterior (*contd.*)—
- massage in, II. 1056
- passive movements in, II. 1056
- pyrexial stage, II. 1055

Politzer's method in patency of Eustachian tube, III. 948

Pollantin, Dunbar antitoxic serum, III. 286-287

Polycythæmia, chronic, with cyanosis and enlarged spleen, II. 84

Polydactylism, I. 943

Polyneuritis of auditory nerve caused by general neurasthenic state of the system, III. 977

Polypus, aural, III. 909-911
- fibrinous, of placenta complicating labour, IV. 228
- fibroid, of the meatus, III. 882
  - uterine, IV. 658-661
- mucous, of cervix, IV. 567, 662
  - of uterus, IV. 662
- multiple, of the colon, II. 588
- of the nose, III. 691
- placental, complicating labour, IV. 228

Polysarcia abdominalis in the menopause, IV. 501

Polyuria of diabetes insipidus, I. 428

Pomegranate root in intestinal tæniasis, III. 518, 519

Ponos, III. 440-441
- prophylaxis of, III. 440
- treatment of, III. 440

Pontine hæmorrhage, II. 1175

Pork, chemical composition of, II. 193

Poroplastic sheet cut for a moulded shoulder cap, I. 588

Port wine in gout, I. 457
- stains, III. 1077
  - carbon dioxide in, III. 1078

Portal vein, thrombosis of, I. 1331; II. 666-667

Posthitis, II. 874

Postures, faulty, in children, I. 56

Pöstyen spa, III. 154

Potam's bottle aspirator apparatus for pleural effusion, I. 1095

Potash, bicarbonate of, in influenza, I. 234
- chlorate of, in ulcerative stomatitis, II. 121

Potassium, bromide of, in exophthalmic goître, II. 55
  - in insomnia, II. 991
  - in whooping cough, I. 380
- chlorate, dosage of in children's diseases, I. 67
  - poisoning by, I. 532
- impotence due to use of, I. 231
- iodide of, in actinomycosis, I. 178
  - in aortic aneurysm, I. 1298
  - in diseases of the heart, I. 1224
  - in gouty joints, I. 436
  - in lead colic, I. 513
  - in new growth in the mediastinum, I. 1178
  - in tabes dorsalis, II. 1087

Potassium, iodide of (*contd.*)—
in typhoid fever, I. 355
in undefined tropical fevers, III. 410
permanganate in gastric lavage, I. 528-531
salts in sub-acute gout, I. 435
Potato diet in gout, I. 453
in dietary of children, I. 59
Potts' disease, line of incision in, I. 916
of the spine, I. 922-927
fracture, I. 629
Pouges spa, III. 154
Poultices in acute bronchitis, I. 1050
in broncho-pneumonia, I. 1067
in chronic rheumatism, I. 486
preparation and use of, I. 33
Poultry, chemical composition of, II. 193
Powders in herpes zoster, II. 1096
in pruritus, III. 1099
Powell (Llewelyn), anæsthetics in pregnancy and labour, IV. 373-381
Pozzuoli spa, III. 154
Practice, medical, general considerations, I. 22
Predisposition to diseases, causes of, I. 5, 6
Pregnancy, abnormalities of, IV. 14-90
abortion in, IV. 14
incomplete in, IV. 21
inevitable in, IV. 18
later than first twelve weeks, IV. 20
missed in, IV. 22
threatened in, IV. 117
accidental hæmorrhage in, Bossi's dilator for, IV. 26
Cæsarean section for, IV. 25
cases before labour has begun, IV. 26-28
hysterectomy for, IV. 25
morphia in, IV. 26
perforation of membranes and, IV. 25
plugging the vagina in, IV. 24
rest in, IV. 24
sedatives in, IV. 24
shock from, IV. 26
use of a dilating bag for, IV. 25
vaginal hysterectomy for, IV. 26
Addison's disease in, IV. 50
affections of the breasts in, IV. 330-336
albuminuria in, IV. 7, 30-33
anæsthetics in, III. 24 ; IV. 58, 375-376
anthrax in, IV. 49
appendicitis in, II. 406 ; IV. 54
ascites in, IV. 55
auto-intoxications in, I. 389
blood or carneous mole, IV. 59
cancer in, I. 128
care of nipples in, IV. 8
cerebro-spinal meningitis in, IV. 49
chorea gravidarum in, IV. 51
clothing during, IV. 8
complicating cancer of the breast, II. 965
pulmonary tuberculosis, I. 1155
complications of, IV. 14-90

Pregnancy (*contd.*)—
cystitis in, IV. 272
danger signals of, IV. 4
death of fœtus during, IV. 14
diabetes insipidus in, IV. 55
mellitus and, I. 425 ; IV. 54
diet during, IV. 6
diphtheria in, IV. 49
diseases of, induction of abortion in, IV. 433
induction of premature labour in, IV. 434
eclampsia in, IV. 34-41
erysipelas in, IV. 49
exercise in, IV. 7
exophthalmic goître in, IV. 57
extra-uterine, complicated with fibroids, IV. 82
conditions simulating rupture of a gravid tube in, IV. 84
risks of operation in, IV. 83
troubles with decidua in, IV. 83
unavailing labour at term, IV. 87
filariasis in IV. 57
general management of, IV. 1-13
treatment of, IV. 3
hæmorrhage, accidental, during, IV. 23-29
occurring after labour, IV. 28
hæmorrhoids in, IV. 42
heart disease in, IV. 52
herpes in, IV. 56
hydatidiform mole in, IV. 59
hydramnios in, IV. 43
chronic, IV. 43
in bicornate uterus, IV. 712
insanity, complicating, IV. 45
intra-abdominal tumours in, IV. 55
jaundice in, IV. 53
later months of, deformities of the fœtus obstructing labour in, IV. 178
leucorrhœa in, II. 557, 558
lobar pneumonia in, IV. 49
malaria in, IV. 48
management of the breasts in, IV. 330
of the nipples in, IV. 330
medicines during, IV. 9
mental diseases complicating, IV. 46-58
minor ailment in, IV. 11
mollities ossium in, IV. 58
myxœdema in, IV. 58
nervous diseases in, IV. 50
oligo-hydramnios in, IV. 44
operations in, IV. 58
osteo-arthritis in, IV. 57
osteo-malacia in, IV. 58
ovarian tumours complicating, IV. 771-772
ovariotomy in, IV. 771
paralyses of, IV. 60
pendulous belly in, IV. 61
pernicious vomiting in, IV. 62-64
starvation in, IV. 62
phthisis in, IV. 49

Pregnancy (*contd.*)—
placenta prævia in, IV. 65
occurring before labour has begun in, IV. 65
pleurisy in, IV. 50
plumbism in, IV. 56
pneumothorax in, IV. 50
prolapse of pregnant uterus in, IV. 70
of the vagina in, IV. 71
prolongation of, induction of premature labour in, IV. 436
pruritus in, IV. 56
vulva in, IV. 72-73
psoriasis in, IV. 56
pyelitis in, II. 806
pyelonephritis of, II. 806
regulation of the bowels in, IV. 8
retroflexion of the uterus in, IV. 74-75
rheumatoid arthritis in, IV. 57
scarlet fever in, IV. 48
spleno-medullary leuchæmia in, IV. 55
syphilis in, IV. 76-77
fœtal in, IV. 77
maternal, IV. 76
table of diseases complicating, IV. 46, 47
tetany in, IV. 51
therapeutics of the unborn infant during, IV. 12
tubal, IV. 78-88
and uterine, concurrent, IV. 81
colpotomy in, IV. 87
conditions simulating rupture in, IV. 84
of a gravid tube in, IV. 84
diagnostic doubts in, IV. 85
expectant treatment of, IV. 78
extra-uterine pregnancy complicated with fibroids in, IV. 82
hysterectomy in, IV. 87
transfusion in hæmorrhage in, IV. 85
treatment of non-gravid tube in, IV. 86
operative, IV. 79
tuberculosis in, IV. 50
typhoid fever in, IV. 48
urticaria in, IV. 56
vaginal examination in, IV. 5
vaginitis in, leucorrheal, IV. 564
varicose veins in, IV. 89-90
vesicular mole in, IV. 59
Premaxillary bones, harelip and, II. 91, 92
Premolars, lower, extraction of, III. 1184
upper, extraction of, III. 1181
Prepuce, œdema of, complicating gonorrhœa, I. 225
of the newborn child, IV. 339
Presbyopia, III. 533
Pressure bandage in ulcers, I. 370
local, in hæmophilia, II. 33
Price (Frederick W.), bronchiectasis, I. 1043-1048
chronic interstitial pneumonia, I. 1074-1075
Price (Frederick W.) (*contd.*)—
pneumokonissis, I. 1115
pulmonary aspergillosis, I. 1116
Prickly heat, III. 470
general management of, III. 470
local treatment of, III. 471
prognosis in, III. 470
Principles of treatment, I. 1-25
Probangs, II. 185
Probe, aural, III. 908
Proctitis, epidemic gangrenous, III. 437
infective ulcerative, II. 610
Proctoclysis, electrical apparatus for, II. 637
in peritonitis, II. 635
Prostate gland, abscess of, II. 922
after-treatment of operation for, II. 922
operation for, II. 922
adenoma of, II. 940-949
complications, II. 944-946
cystitis in, II. 945
epididymitis in, II. 945
hæmorrhage in, II. 945
operations for, conclusions, II. 948
operative treatment, II. 941
palliative treatment, II. 941
perineal prostatectomy in, II. 946-948
prognosis in, II. 946
supra-pubic prostatectomy in, II. 942
calculi of, II. 918
in bed of, complicating adenoma of prostate, II. 945
carcinoma of, II. 933
operation for, conclusions, II. 940
permanent supra-pubic drainage in, II. 939
diseases of, II. 918-929
endothelioma of, II. 932
enlargement of, permanent, obstruction to micturition in, II. 930
X-rays in, III. 367
fibroma of, II. 950-951
perineal prostatectomy for, II. 950
malignant tumours of, II. 932-938
operation for, II. 933
sarcoma of, II. 932
syphilis of, II. 927
tumours of, II. 930-949
obstruction to micturition in, II. 930
wounds of, II. 919
Prostatectomy, perineal, advantages of, II. 948
after-treatment of, II. 947
disadvantages of, II. 948
for fibroma of the prostate, II. 950
in adenoma of the prostate, II. 946
operation of, II. 946
supra-pubic, in adenoma of the prostate, II. 942
Prostatic veins, thrombosis of, I. 1331
Prostatitis, acute, II. 920-923
recto-urethal fistula and, II. 923
chronic, II. 924-926

Prostatitis, chronic (*contd.*)—
    Janet's method of posterior irrigation in, II. 925
    complicating gonorrhœa, I. 226
  gouty, II. 926
  onanitic, II. 927
  tuberculous, II. 928-929
Proteid food and over-nutrition, I. 451
Protein diet for diabetics, I. 419
  effect of, on kidneys, II. 204
  food in dietetics, II. 200
  foods arranged in order of value in, II. 197
Proteins, digestion of, II. 191
Protene Company diabetic food, I. 414, 418
  flour, I. 423
Prurigo, III. 1096
Pruritus, alcohol in, III. 1098
  carbolic acid in, III. 1098
  chemical remedies in, III. 1098
  complicating diabetes mellitus, I. 425
    pregnancy, IV. 56
  creams in, III. 1099
  electrical methods in, III. 1101
  external treatment of, III. 1098
  general remarks on, III. 1097
  gouty, I. 446
  hydrotherapy in, III. 1100
  ichthyol in, III. 1099
  in jaundice, II. 670
  internal treatment of, III. 1098
  lead in, III. 1099
  localised, III. 1100
  lotions for, III. 1098 ; IV. 530
  of the vulva, IV. 517-519
  opium in, III. 1099
  or itching, III. 1097-1101
  physical methods in, III. 1100
  powders in, III. 1099
  tar in, III. 1099
  X-rays in, III. 359
Pruritus ani, II. 593 ; III. 1102-1105
  electrical methods in, III. 1104
  local treatment of, III. 1103
  vulvæ, III. 1106-1108
  complicating pregnancy, IV. 72-73
  treatment of, local, III. 1107
Prussic acid, poisoning by, I. 530
Pseudo-angina pectoris in gout, I. 444
  dipsomania, I. 498
  leukæmia, II. 42
  osteomalacic pelvis complicating labour, IV. 172
Psoas abscess, I. 916
    evacuation of, in tuberculous disease of the spine, I. 931
  contraction in Potts' disease of the spine, I. 927
Psoriasis, III. 1109-1123
  after-treatment of, III. 1122
  alkalies in, III. 1114
  anthrarobin in, III. 1119
  arsenic in, III. 1111
  chrysarobin in, III. 1117
  complicating pregnancy, IV. 56
Psoriasis (*contd.*)—
  diet in, III. 1110
  general management of, III. 1110
  general remarks on, III. 1109
  of the nails, III. 1121
  of the scalp, III. 1121
  pyrogallol in, III. 1121
  salicin in, III. 1114
  tar in, III. 1119
  thyroid extract in, III. 1114
  treatment of, internal, III. 1111
    local, III. 1115
  tuberculous, III. 1152
  X-rays in, III. 351, 1122
Psychalgia, II. 1123
Psychasthenia, II. 1044-1046
  agoraphobia in, II. 1044
  claustrophobia in, II. 1044
  echolalia in, II. 1045
  treatment of, II. 1046
Psychical impotence, I. 231, II. 911
Psycho-analysis in hysteria, II. 1010
Psychoses associated with changes in thyroid gland, II. 1301-1302
  exhaustion, II. 1299-1300
  toxic, II. 1303-1304
Psychotherapy in constipation in adults, II. 441
  in melancholia, II. 1295
  in morphinism, I. 519
Pterygium of conjunctiva, III. 561
Ptomaine poisoning or bacterial food poisoning, I. 507-510
Ptosis, adiposa, III. 650
  congenital, III. 650
  Fuchs' myopathic, III. 650
  hysterical, III. 650
  morning, III. 650
  neurasthenic, III. 650
  of ocular muscles, III. 650
  of the eyelids, III. 579
  reflex, III. 650
Ptyalism, II. 130
  and inflammation of parotid gland, II. 161
Puberty, dysmenorrhœa in, IV. 501
  management of, IV. 498-501
  mastitis at, II. 960
  menorrhagia in, IV. 501
  precocious, IV. 500
Pubic dressing in operation for elephantiasis scroti, III. 513
Pubiotomy, IV. 446-450
  Gigli's saw in, IV. 447
  in contracted pelvis complicating labour, IV. 171
  operation of, IV. 447
  results of, IV. 448
Puddings, necessary in dietary of children, I. 59
Pudenda, granuloma of, constitutional treatment of, III. 457
    local treatment of, III. 457
    palliative measures in, III. 458
  ulcerating granuloma of, III. 457-458

Puerperal infection, IV. 282-323
  bacteriology of, IV. 284
  consecutive lesions in, IV. 283
  metastatic lesions in, IV. 283
  method of, IV. 285
  nature of lesion in, IV. 282
  primary lesion in, IV. 282
 insanity, IV. 277-278
 mania, hypnotism in case of, III. 173
 neuritis, II. 1139
 sepsis, abdominal drainage in, IV. 300
  administration of saline solution in, IV. 311
  application of strong antiseptics to the uterus in, IV. 310
  curative treatment of, IV. 294-307
  curettage of the uterus in, IV. 299
  drainage of pelvic cellular tissue in, IV. 306
  drainage of the pelvis in, by vaginal incision, IV. 302
  drugs in, IV. 313
  eclampsia and, IV. 34-41
  empty uterus and, IV. 290
  femoral thrombo-phlebitis in, IV. 321
  fever, breast, in, IV. 315
   continued in, IV. 317
   early acute, in, IV. 317
   early slight, in, IV. 314
   reaction in, IV. 315
  free vaginal drainage in, IV. 290
  general management of, IV. 313
  hysterectomy in, IV. 302
  identification of causative organism in, IV. 307
  intra-uterine douching in, IV. 310
  isolation of causative organism in, IV. 307
  ligation of pelvic veins in, IV. 304
  notification of, IV. 322
  nursing in, IV. 313
  particular classes of, treatment, IV. 314-323
  phlegmasia alba dolens in, IV. 321
  prevention of, IV. 287-294
  prevention of injury to the soft parts in, IV. 292
  removal of a pyosalpinx in, IV. 307
  re-sterilisation of general tract after probable infection in, IV. 290
  salpingectomy in, IV. 300
  serum treatment of, IV. 308
  sterilisation of hands in, IV. 288
   instruments in, IV. 288
   lower genital tract in, IV. 289
  treatment of, non-operative, IV. 307-314
  uterine exploration in, IV. 295
  vaccine treatment of, IV. 309
  vaginal douching of, IV. 311
aginitis, IV. 562
rperium, affections of the breasts in, IV. 330-336
mplications of, IV. 272-276
stitis in, IV. 272

Puerperium (*contd.*)--
 fever, late, in, IV. 320
 galactocele in, IV. 336
 mastitis in, IV. 334-335
 nipples, depressed in, IV. 332
  sore in, IV. 333
 normal, anatomy of, IV. 257
  blood in, IV. 258
  bowels in, IV. 266
  breast-feeding in, IV. 266
  breasts in, IV. 258
  care of breasts in, IV. 266
  cleanliness of vulva in, IV. 260
  contra-indications to breast-feeding in, IV. 268
  diet in, IV. 269
  involution of uterus in, IV. 261
  lochia in, IV. 257, 262
  management of, IV. 256-271
  pain in, IV. 264
  passage of urine in, IV. 265
  pelvic organs in, IV. 257
  physiology of, IV. 257
  pulse in, IV. 261
  removal of, discharges in, IV. 260
  sleep in, IV. 264
  temperature in, IV. 261
  time of staying in bed in, IV. 270
  urine in, IV. 258
  uterus in, IV. 257
  vagina in, IV. 257
 painful engorgement of, breasts in, IV. 331
 paralysis associated with, IV. 281
 pulmonary embolism in, IV. 324-325
 tetanus in, IV. 326-327
 tumours of ovary complicating, IV. 790
 urethritis in, IV. 329
Pulley and weight for elbow exercises, I. 778
 extension apparatus for fractures, I. 576
Pulp, diseases of, III. 1173
Pulse, failure of, in cholera, III. 426
 in gynæcological surgery, IV. 487
 in normal puerperium, IV. 261
 in typhoid fever, I. 364
Pulse-rate as a guide to treatment in pulmonary tuberculosis, I. 1141
 in non-operative appendicitis, II. 424
Pupils, condition of in cerebral compression, I. 880
 dilatation of, after mature cataract, III. 630
Purgation, in intra-cerebral hæmorrhage, II. 1171
 predisposes to shock, I. 95
Purgatives, anthracene, in constipation in adults, II. 447
 choice of, in constipation in adults, II. 445
 dosage of, in constipation in adults, II. 445
 in ascites, II. 627
 in constipation in adults, II. 444
 in non-operative appendicitis, II. 423

Purgatives (*contd.*)—
  - in peritonitis, II. 638
  - in tæniasis intestinal, III. 518
  - in typhoid fever, I. 355
  - mercurial, in constipation in adults, II. 450
  - saline, in constipation in adults, II. 449
  - synthesised, in constipation in adults, II. 449
  - vegetable, in constipation in adults, II. 447, 454

Purin bodies, effect of in food, II. 207

Purin-free diet in gout, I. 452

Purpura, II. 43-45 ; III. 1124
  - general treatment of, II. 43
  - hæmorrhagica, II. 44
  - medicinal treatment, II. 44

Purslow (**C. E.**), air embolism in labour, IV. 161-162
  - albuminuria during pregnancy, IV. 30-33
  - complications of the puerperium, IV. 272-276
  - eclampsia, IV. 34-41
  - insanity of lactation, IV. 279
  - insanity of pregnancy, IV. 45
  - paralyses associated with labour, IV. 280
  - paralyses of pregnancy, IV. 60
  - puerperal insanity, IV. 277-278
  - pulmonary embolism in the puerperium, IV. 324-325
  - tetanus in the puerperium, IV. 326-327
  - tetany in the puerperium, IV. 328
  - urethritis in the puerperium, IV. 329

Pus, evacuation of in Bier's treatment, III. 50
  - formation, Gauvain's method in, I. 757
  - in abcess of the liver, II. 649
  - in the liver, needle in search for, II. 650
  - in pelvic cellulitis, IV. 828
  - tuberculous, antibacterial properties of, I. 174

Pustulation in herpes zoster, III. 1043

Pyæmia and septicæmia, general and local treatment of, I. 295-298

Pyelitis, II. 803-806
  - diagnosis of, II. 803
  - in childhood, II. 805
  - of infancy, II. 805
  - of pregnancy, II. 806
    - operative treatment of, II. 806
    - treatment of, II. 806

Pyelolithotomy for renal calculus, II. 763, 764

Pyelonephritis, ascending, II. 810
    - acute, II. 811
    - acute operative treatment of, II. 811
    - chronic, II. 812
    - prognosis in, II. 810
  - hæmatogenous, II. 807
  - infective, II. 807-813
    - drugs in, II. 808
    - medicinal treatment of, II. 808
    - operative treatment of, II. 809

Pyelonephritis, infective (*contd.*)—
    - prognosis in, II. 807
    - vaccine treatment of, II. 808
  - of pregnancy, II. 806
  - primary, II. 807
  - secondary, II. 810

Pylephlebitis, suppurative, of the liver, II. 666

Pylerodiosis for pyloric stenosis, II. 316
  - Loreta's operation, II. 317

Pylorectomy for hypertrophic pyloric stenosis, II. 342
  - for pyloric stenosis, II. 316
  - in gastric cancer, II. 306

Pyloroplasty for hypertrophic stenosis of the pylorus, II. 339, 342, 343
  - for pyloric stenosis, II. 316
  - in ulcer of the stomach, II. 385
  - three stages of operation of, II. 384

Pylorus, congenital atresia of, II. 344
  - hyperplasia of, II. 337
  - obstruction of, due to gastric cancer, I. 140
  - stenosis of, II. 312-315
    - in gastric cancer, II. 298
    - surgical treatment, II. 316
    - hypertrophic, II. 337-341
      - after-treatment in, II. 340
      - infantile, II. 338
      - spasm in, II. 337
      - surgical measures, II. 339-342
        - treatment of, II. 342-344

Pyonephrosis, II. 814-818
  - drainage by ureteral catheter, II. 815
  - nephrectomy in, II. 817
  - nephrostomy in, II. 815
  - plastic operations in, II. 815
  - X-rays in, II. 814

Pyopneumothorax, I. 1113
  - cases of an entirely tuberculous nature, I. 1114.
  - surgical treatment of, 1114

Pyorrhœa alveolaris, III. 1176
  - vaccine therapy of, III. 287

Pysosalpinx, removal of, in puerperal sepsis, IV. 307

Pyothorax in injuries of the thorax, I. 1029

Pyrexia, complicating operation for goître, II. 69
  - in fevers, relief of, I. 159
  - in typhoid fever, I. 348
  - of relapsing fevers, I. 266

Pyridine, poisoning by, I. 533

Pyrmont spa, III. 154

Pyrogallic acid in lupus, III. 1150

Pyrogallol in psoriasis, III. 1121

Pyuria, II. 749

Quackery, cancer cures and, I. 147, 148

Quarantine for small-pox, I. 310

Quinine in arthritis deformans, I. 395
  - in blackwater fever, III. 386
  - in chlorosis, II. 27

Quinine (*contd.*)—
  in chronic dysentery, III. 434
  in gonorrhœal arthritis, I. 783
  in typhoid fever, I. 352
  in undefined tropical fevers, III. 410
  in whooping cough, I. 382
  ointment inunction of, I. 70
  rectal administration of, III. 396
  use of, in malaria, III. 392, 394
  value of during convalescence, I. 65

Rabies, I. 264-265
  incubation period in, I. 265
  Pasteur's inoculation method of treatment, I. 264
  treatment at sight of, I. 264
  yeast in, III. 288
Racket incision in amputations, I. 796
Radiant heat, treatment by, III. 316-326
Radicular odontomes, II. 110
Radio-active waters in rheumatism, I. 491
Radio-activity, induction of, III. 315
  of mineral waters, I. 458
  of waters, III. 115
Radium, application of, to the mucous cavities, III. 308
    to the skin, III. 308
  effect of on growth of cancer cells, I. 129
  in cancer, I. 155
    of cervix, IV. 615
  in epithelioma of, II. 139, 144
  in lupus, III. 1150
    erythematosus, III. 1071
  in rodent ulcer, I. 115
  in small capillary nævi, III. 1079
  therapy, III. 303-315
    caustic method in, III. 308
    combined with surgical operations, III. 313
    composite-ray apparatus in, III. 305
      method in, III. 305
    induction of radio-activity in, III. 315
    introduction of tubes into the tissues in, III. 311
    method of irradiation by, III. 303
    methods of use, III. 308
    topographical view of, III. 306
    ultra-penetrant ray apparatus in, III. 305
      method in, III. 305
  tubes, introduction of, into the tissues, III. 311
Radius, absence of, I. 936
  Colles's fracture of, I. 578
  congenital defects of, I. 936
    dislocation of head of, I. 936
  dislocations of, I. 721
  epiphysis of, lower, separation of, in fractures, I. 603
  fracture of, I. 686
  head of, fracture of, I. 598
Radius (*contd.*)—
  separation of the upper epiphysis of, in fractures, I. 599
  shaft of, fracture of, I. 599, 600, 601
Ragatz-Pfaefer's spa, III. 154
Ranula cyst and inflammation of the parotid gland, II. 158
  of floor of mouth, II. 145
  of the tongue, II. 145
Rashes following ether anæsthesia, III. 9
  use of antitoxin, I. 193
Rational treatment, principles of, I. 2
Raw beef essence, preparation of, I. 42
Raynaud's disease, I. 218-219; II. 1238-1241
  gangrene in, II. 1240
  general treatment of, I. 218
  local treatment of, I. 218
  of the auricle, III. 880
Rays, infra-penetrant, III. 304
  ultra-penetrant, III. 304, 310
Reach in physical exercises, III. 230
von Recklinhausen's disease, I. 112; III. 1074
Rectal feeding in scarlet fever, I. 284
    in stricture of the œsophagus, II. 171
    methods of, I. 29
  infusion in shock, I. 99
  injections for lowering temperature, I. 69
Rectocele of the vagina complicated by ulceration, IV. 547
  operative treatment, IV. 551
  palliative treatment of, IV. 547
  surgical treatment of, IV. 693
Recto-urethral fistula and acute prostatitis, II. 923
Recto-vaginal fistulæ, complications of, II. 609
Rectum, administration of fluids by, in peritonitis, II. 635
    quinine by, in malaria, III. 396
  cancer of, relief of obstruction in, I. 141
  diseases of, II. 593-625
    in bilharzia, III. 500
  enemata by, in constipation in adults, II. 455
  in Wertheim's operation, IV. 607
  malignant growths of, II. 625
  neurosis of, II. 614
  operations up, anæsthetics in, III. 32
  pain in, II. 614
  procidentia of, II. 621-623
  prolapse of, II. 621-623
  operations for, II. 622
  simple tumours of, II. 624
  symptoms in paraplegia. II. 1199
  wound of, complicating perineal prostatectomy in adenoma of prostate, II. 948
Rectus abdominalis, tetanic rupture of, II. 249
Red light, use of, III. 187
  bath, III. 193

- **Reflector** bath in radiant heat therapy, III. 321
- **Reflex** epilepsy, II. 991
- **Refraction** and cataract, III. 618
  - errors of, headache in, II. 1033
  - of the eye, errors of, III. 528-542
- **Régime** lactée in chronic congestion of the lungs, I. 1079
- **Reichenhall** spa, III. 154
- **Reichmann** on irrigation of the stomach, II. 365
- **Relapse** in rheumatism, acute, I. 273
  - in childhood, I. 279
- **Repair**, factor of inflammation, I. 10
  - process of, influence of nervous system on, I. 12
- **Resistance**, natural, to pathological processes, I. 3, 5
- **Resolvent** baths, III. 126
- **Respiration**, artificial, in electrical injuries and burns, I. 547
    - in poisoning, I. 530, 532, 534
    - Schultze's method of, in asphyxia of newborn child, IV. 352
  - children to be taught correct method of, I. 49
  - effect of shock on, I. 94, 97
  - impaired in diphtheritic paralysis, I. 201
  - rate in gynæcological surgery, IV. 487
  - *See also* Breathing.
- **Respiratory** organs, cancer of, relief of obstruction in, I. 142
  - system and typhoid fever, I. 360
    - anthrax of, I. 179
  - tract, upper, chronic hyperplasia of mucous membrane of, III. 774
- **Rest** and fixation in tuberculous disease of the hip-joint, I. 755
    - of the knee-joint, I. 765
  - and pelvic support for applying a plaster spica to the hip, I. 946
  - automatic provision of, I. 16
  - during accidental hæmorrhage in pregnancy, IV. 24
    - arthritis deformans, I. 392
  - importance of in treatment, I. 12
  - in acute endocarditis, I. 1191
  - in acute rheumatism, 269, 274
  - in aortic aneurysm, I. 1299
  - in bed in gynæcological surgery, IV. 489
  - in chlorosis, II. 20
  - in chorea, II. 1260
  - in diphtheria, I. 187
  - in diseases of the heart, I. 1203
  - in exophthalmic goître, 54
  - in guides to the control of auto-inoculation, I. 1162
  - in hæmorrhage, I. 1262
  - in pernicious anæmia, II. 1
  - in pleurisy, I. 1093
  - in pulmonary tuberculosis, I. 1122
  - in rheumatism (chronic), I. 489
  - in treatment of ulcers, I. 368
  - in the tropics, III. 379
  - in tuberculous disease of joints, I. 752
- **Rest** (*contd.*)—
  - in wounds, I. 554
  - influence of in dietetics, II. 199
  - question of, for young children, I. 56
  - stage in sanatorium treatment of tuberculosis, I. 1128
  - therapeutic value of, I. 16
- **Restlessness** complicating acute rheumatism, I. 272
- **Retina**, arteria centralis of, embolism of, III. 644
  - detachment of, III. 643
  - diseases of, III. 642-644
  - tumours of, III. 644
- **Retinal** veins, thrombosis of, III. 644
- **Retinitis** complicating diabetes mellitus, I. 426
  - pigmentosa, III. 644
- **Retro-peritoneal** lipoma, I. 106
- **Retro-pharyngeal** abscess, III. 789-790
  - in diseases of the spine, I. 916
- **Retro-rectal** abscess of the anus, II. 604
- **Rheinerz** spa, III. 155
- **Rheinfelden** spa, III. 155
- **Rheumatic** fibrositis, II. 1023, 1121
- **Rheumatism** (acute), I. 268-275
    - calomel or hydrargyrum cum creta in, I. 270
    - complications of, I. 272
    - convalescence from, I. 273
    - diet in, I. 270
    - general measures in, I. 269
    - in anæmia, II. 15
    - local applications in, I. 269
    - medicinal measures in, I. 270
    - persistence of temperature in, I. 272
    - prophylaxis of, I. 275
    - salicylates in, I. 271
    - serum treatment of, I. 272
  - affections of the throat in, III. 764
  - (chronic), I. 483-491
    - allied conditions of, I. 483
    - clothing in, I. 485
    - diet in, I. 486
    - drugs in, I. 490
    - electricity in, I. 488
    - exercise in, I. 489
    - external applications in, I. 486-488
    - heat therapy in, I. 486
    - ionisation in, I. 488
    - liniments for, I. 487
    - massage in, I. 488
    - rest in, I. 489
    - spa treatment, I. 491
  - climate for, III. 94
  - gonorrhœal, I. 228
  - hypnotism in case of, III. 171
  - (in childhood), I. 276-279
    - after-treatment of, I. 279
    - cardiac lesions in, I. 278
    - details of treatment calling for special comment, I. 277
    - drugs in, I. 278
    - prophylaxis of, I. 277

- **Rheumatism** (in childhood) (*contd.*)—
        - treatment of, every rheumatic manifestation, I. 277
    - iritis in, III. 587
    - mineral waters, and baths in, III. 142
    - (muscular), I. 492-494
        - chronic, massage in, III. 209
        - drugs in, I. 493
        - heat therapy in, I. 493
        - massage in, I. 494
    - myositis in, II. 1324
    - neuritis in, II. 1130
    - paralysis of ocular muscles in, III. 649
    - pericarditis in, I. 1179
    - scarlatinal, I. 290
    - use of the blister in, I. 69
- **Rheumatoid** arthritis. *See under* Arthritis.
    - conditions, climate for, III. 94
- **Rhinitis**, acute, III. 701-704
        - prophylaxis of, III. 702
        - simple, III. 701
    - atrophic, III. 706
        - local treatment of, III. 707
    - chronic, III. 705-712
        - anti-toxins in, III. 709
        - friction in, III. 709
        - general treatment of, III. 708
        - local complications of, III. 708
        - packing the nose in, III. 708
        - paraffin injections in, III. 709
        - simple, III. 705
        - vaccine treatment of, III. 709
        - vibratory massage in, III. 709
    - fibrinous, III. 703
    - hypertrophic, III. 710
        - chronic, and Eustachian obstruction, III. 946
    - purulent, III. 703
    - sicca, III. 711
        - anterior of nose, III. 665
        - local treatment of, III. 711
    - traumatic, III. 704
    - vasomotor, III. 704
- **Rhinoliths**, III. 669
- **Rhinophyma**, III. 1135-1136
- **Rhinorrhœa** in scarlet fever, I. 282
    - paroxysmal, III. 689
    - vasomotor, III. 689
- **Rhinoscleroma**, III. 713
- de **Ribes'** bag, IV. 186
        - central insertion of in placenta prævia, IV. 67, 68
        - in forcible methods of delivery, IV. 442
    - in induction of premature labour, IV. 440
    - in placenta prævia, IV. 66, 68
    - position of in uterus in induction of premature labour, IV. 441
- **Ribs** cartilage, of tuberculous disease of, I. 1032
    - cervical, brachial plexus injury and, II. 1012
        - injury of brachial plexus in, II. 1110
- **Ribs** (*contd.*)—
    - fracture of, in newborn child, IV. 352
    - inflammation of, I. 1032-1033
    - new growths of, I. 1034
    - re-section of, in generalised empyema, I. 1104
    - syphilis of, I. 1032
    - tuberculous disease of, I. 1032
- **Richet** (**Charles**), method of hypnotism, III. 165
- **Rickets**, climate for, III. 96
    - clothing in, I. 478
    - cod-liver oil in, I. 66
    - deformities of, I. 970-972
        - of bones in, I. 481
    - diet in, I. 479
    - digestive disorders in, I. 479
    - drugs in, I. 479
    - hydrotherapy in, I. 478
    - in anæmia, II. 14
    - in newborn child, IV. 371
    - open-air treatment, I. 478
    - special measures in, I. 480
- **Ricketts** (**T. F.**), small-pox, I. 302-311
    - vaccination, I. 311-314
- **Ricord's** paste in soft chancre, I. 315
- **Riedel's** lobe of the liver, II. 659
- **Rigg's** disease, vaccine therapy of, III. 287
- **Ring** forceps, IV. 475, 476
- **Ringworm**, III. 1125-1131
    - in the tropics, III. 478
    - of the beard, III. 1130
    - of the nails, III. 1082, 1131
    - pustular, III. 1129
    - X-rays in, III. 354, 1125
- **Rippoldsau** spa, III. 155
- **Robert's** pelvis complicating labour, IV. 173
- **Roberts** (**C. Hubert**), pubiotomy, IV. 446-450
    - symphysiotomy, IV. 452-460
- **Roberts** (**J. Reid**), typhoid fever, I. 335-364
- **Roberts** (**Sir Wm.**), paraffin in skin eruptions, I. 446
- **Robson** (**A. W. Mayo**), acute post-operative dilatation of the stomach, II. 311
    - fistulæ of the gall-bladder and bile ducts, II. 698-699
    - hour-glass stomach, II. 334-336
    - inflammatory affections of the gall bladder and bile ducts, II. 700-709
    - injuries and diseases of the pancreas, II. 716-729
    - injuries of the bile passages, II. 680-681
    - injuries to the stomach, II. 282
    - perforation of ulcer of the duodenum, II. 396-398
    - perforation of ulcer of the stomach, II. 389-390
    - surgical treatment of cancer of the stomach, II. 302-309
    - surgical treatment of cholelithiasis, II. 686-697

- **Robson (A. W. Mayo)** (*contd.*)—
  - surgical treatment of gastroptosis, II. 323-324
  - surgical treatment of hæmorrhage, II. 331-333
  - surgical treatment of pertrophichy pyloric stenosis, II. 342-344
  - surgical treatment of pyloric stenosis and obstructive dilatation, II. 316-317
  - surgical treatment of ulcer of duodenum, II. 391-394
  - surgical treatment of ulcer of stomach, II. 382-388
  - tetany of stomach, II. 399
  - tumours of bile ducts, II. 713-715
    - of gall bladder, II. 710-712
    - (simple) of stomach, II.
  - volvulus of the stomach, II. 400
- **Rodagen** in exophthalmic goitre, II. 56
- **Rodent** ulcer, III. 1132-1134
  - excision of, I. 114
    - free and wide, III. 1132
  - extension of, I. 123
  - Finsen light in, III. 1134
  - freezing in, I. 115
  - ionic medication of, III. 184
  - ionisation in, III. 1133
  - of the cornea, III. 566
  - of vulva, IV. 508
  - radium in, I. 115
  - Röntgen rays in, III. 1133
  - solid carbon dioxide in, I. 115
  - spread of, I. 125
  - X-rays in, I. 114
- **Rolleston (H. D.)**, acute yellow atrophy of the liver, II. 657-658
  - anomalies in form and position of the liver, II. 659
  - ascites, II. 626-631
  - cholelithiasis, II. 682-685
  - degenerations of the liver, II. 668
  - functional derangement of the liver, II. 668
  - hydatid cysts of the liver, II. 669
  - hypertrophic biliary cirrhosis (Hanot's disease), II. 664
  - jaundice, II. 670-675
  - lardaceous or amyloid liver, II. 675
  - portal or common cirrhosis of the liver, II. 660-663
  - syphilitic cirrhosis of the liver, II. 665
  - thrombosis of the portal vein, II. 666-667
  - tumours of the liver, II. 679
- **Romer (Frank)**, sprains, I. 737-740
- **Roncegno** spa, III. 155
- **Röntgen** rays. *See under* X-rays.
- **Rood's** apparatus for intravenous anæsthesia, III. 35
- **Rooms**, aspect of, to be south or west, I. 44
  - preparation of, for operation, I. 26-31
- **Roots** of teeth, lower, extraction of, III. 1186
- **Rosacea**, III. 1135-1136
- **Rotch** on modified milk in infant feeding, II. 224
- **Roth-Drager** apparatus for anæsthetics, III. 14.
- **Roughton's** splint, I. 630
- **Roulte's** flushing curette in retained placenta, IV. 227
- **Round** ligaments, shortening of, in retroflexion of the uterus, IV. 681
- **Roux's** curette, IV. 624
- **Rowntree (Cecil)**, general principles of the treatment of cancer, I. 116-156
  - surgical treatment of tumours, I. 106-156
- **Royat** spa, III. 155
- **Rubber** cord, application of, in elephantiasis scroti, III. 505
  - gloves in gynæcological operations, IV. 483
  - goods, disinfection of, I. 161
  - tooth cleaner, II. 128
  - tourniquet in hæmorrhage, I. 1258
- **Rubella**, I. 280
- **Rudel** on urea solution, I. 437
- **Rupture** of muscles, II. 1322
  - subcutaneous, of tendons, II. 1328.
- **Russell (J. Risien)**, disseminated sclerosis, II. 1070-1076
  - tabes dorsalis, II. 1085-1092
- **Rye** bread, gangrene from use of, I. 219

- **Saccharin** in obesity, I. 472
- **Saccharine** foods in gout, I. 453
- **Sacculus** of the female urethra, IV. 870
- **Sacro-iliac** disease, I. 920
  - joint, tuberculous disease of, I. 780
- **Sacrum**, fracture of, I. 608
- **Saint-Armand** spa, III. 155
- **St. George's** Hospital diet table, II. 202
  - statistics of appendicitis at, II. 402
- **Saint-Gervais** spa, III. 155
- **Saint-Honoré** spa, III. 155
- **St. Moritz** spa, III. 155
- **St. Nectaire** spa, III. 155
- **St. Sauveur** spa, III. 155
- **St. Thomas'** Hospital, table of cases of acute peritonitis at, II. 633
- **Sal alembroth** gauze and wool, I. 78
- **Salads**, danger of, in the tropics, III. 384
  - vegetables and, in obesity, I. 472
- **Salicine** in influenza, I. 234
  - in psoriasis, III. 1114
- **Salicylate** of soda in erythema nodosum, I. 213
  - in rheumatism in childhood, I. 278
  - ionisation with, I. 488
- **Salicylates**, action of, I. 388
  - in acute rheumatism, I. 271
  - in chronic rheumatism, I. 487
  - in typhoid fever, I. 352
- **Salicylic** acid in lupus, III. 1150
  - gauze and wool, I. 78
- **Salies de Béarn** spa, III. 155

Saline enema, I. 33
  infusion in hæmorrhage, I. 1262
    intravenous, in eclampsia, IV. 35
    subcutaneous in eclampsia, IV. 35
  intra-peritoneal, administration of, in hæmorrhage, I. 1268
  normal, infusion of, in shock, I. 98
  purgatives in constipation in adults, II. 449
  solution, administration of, in puerperal sepsis, IV. 311
    injection of, in sciatica, II. 1027
    intravenous injection of, in scarlet fever, I. 288
Salines in alcoholic gastritis, II. 353
Salins spa, III. 156
Salins-Moutiers spa. *See* Brides les Bains.
Salisbury dietary in chronic rheumatism, I. 486
  treatment of obesity, I. 468, 471
Salit liniment in rheumatism, I. 487
Salivary calculi and inflammation of parotid gland, II. 159
  fistula and inflammation of the parotid gland, II. 160
  glands, diseases of, II. 130-131, 157-163
    injuries of, II. 157-163
Salivation and inflammation of parotid gland, II. 161
  increased, II. 130
Salmon's truss for inguinal hernia, II. 527
Salol in typhoid fever, I. 354
Salpingectomy in puerperal sepsis, IV. 300
Salpingitis, IV. 805-814
  acute, of Fallopian tube, IV. 810
  chronic, of Fallopian tube, IV. 813
  gonococcus in, IV. 831
  gonorrhœal, in children, IV. 807
  of Fallopian tubes, IV. 821-830
    complicating cancer of the uterus, IV. 830
  preventive treatment of, IV. 815
  septic infection of tubes in, IV. 807
  streptococcus in, IV. 831
  treatment of, preventive, IV. 831
  tubercle bacillus in, IV. 831
  tuberculous, IV. 833-835
Salpingostomy in inflammation of Fallopian tubes, IV. 809
Salsomaggiore spa, III. 156
Salt contra-indicated in obesity, I. 470
  diminution of, in typhoid fever, I. 343
  effect of, on kidneys, II. 206
  muriated waters, III. 118, 129
  restriction of, in chlorosis, II. 28
Salts in malaria, III. 393
  irritant, poisoning by, I. 528-530
Salvarsan ("606") in spinal syphilis, I. 917
  in Frambœsia tropica, III. 463
  in syphilis, I. 149, 322
  in tabes dorsalis, II. 1088
Sanatorium treatment of pulmonary tuberculosis, I. 1127-1158
Sand baths, III. 136
  flea (dermatophiliasis), III. 481
  fly fever, III. 400
Sandefjord spa, III. 156
Sandwith (F. M.) pellagra, I. 521-524
Sanitas a useful douche, I. 137
  Electrical Co.'s vibrator, III. 214
Santonin in ascariasis, III. 494
Sarcoid of Boeck, multiple benign, III. 1152
Sarcoma, amputation in, I. 791
  Coley's fluid in, I. 153, 920; III. 299
  cutis, III. 1037
  extension of, I. 124
  melanotic, true nature of, I. 125
  of bones, I. 711
  of muscle, II. 1325
  of nerves, II. 1044-1142
  of the breast, II. 975
  of the female urethra, IV. 872
  of the gall bladder, II. 712
  of the jaws, II. 112
  of the prostate, II. 932
  of the scalp, I. 893
  of the spleen, II. 81
  of the tongue, II. 144
  of the umbilicus, II. 281
  of the uterus, IV. 718-719
    leucorrhœa in, IV. 571
  of the vulva, IV. 516
  operability of, I. 122
  primary, of the vagina, IV. 553
  radium therapy of, III. 312
  secondary growths of, I. 125
Sarcomata, myeloid, of the jaw, II. 110
  of the bones of the skull, I. 895
Sarsaparilla in syphilis, I. 323
Saturnine cachexia in lead poisoning, I. 514
  encephalopathy in lead poisoning, I. 514
Saugman's needle in artificial pneumothorax, I. 1167
Saundby (Sir Robert), enteritis (acute and chronic) in adults, II. 479-482
Sausages, chemical composition of, II. 193
  poisoning by, I. 510
Savin, poisoning by, I. 533
Saxin in obesity, I. 472
Sayres's strapping in fractures, I. 583-586
Scabies, III. 1137-1138
Scafati (Signor), and voice production, III. 338
Scalds of the trachea, III. 797
  and burns, I. 540-544
    general treatment of, I. 543
    immediate treatment of, 540
    local treatment of burnt areas in, I. 540
    treatment of contractions following, I. 543

Scale preparations in chlorosis, II. 24
Scalp, alopecia dependent on morbid conditions of, III. 1000
  avulsion of, I. 875
  bald, after X-rays, "5-exposure method," III. 358
  contusions of, I. 873
  dermoid cysts of, I. 110
  generalised infections of, I. 888
  hæmorrhage from, I. 1275
  infective lesions of, I. 888
  injuries of, I. 873-875
  localised infections of, I. 888
  psoriasis of, III. 1121
  scales on, in psoriasis, III. 1116
  seborrhœa of, III. 1141
  soreness of, neuralgic headache in, II. 1116
  surgical diseases of, I. 888
  tumours of, I. 892-896
  wounds of, I. 874
Scapula, acromion process of, fracture of, I. 586
  coracoid process of, fracture of, I. 586
  detachment of, in Berger's operation, I. 834
  fractures of, I. 585-586
  neck of, fracture of, I. 585
  neuralgia, II. 1121
Scarification in cheloid, III. 1018
  in lupus, III. 1149
Scarlet fever, I. 281-294
  acute inflammation of middle ear in, III. 902
  adenitis complicating, I. 290
  arthritis complicating, I. 290
  cardiac affections complicating, I. 293
  cervical cellulitis complicating, I. 290
  complicating pregnancy, IV. 48
  complications of treatment of, I. 289
  diet in, I. 283
  general management of, I. 281
  hyperpyrexia in, I. 289
  infectivity of, I. 282
  nephritis complicating, I. 292
  otitis media complicating, I. 289
  remedial treatment of, I. 284
  " return cases " of, I. 282
  septic, I. 283, 284, 287
  serum therapy in, I. 286
  toxic, I. 288
  ulcerative stomatitis in, I. 293
  vaccine therapy of, I. 288
Scars in burns and scalds, I. 543
  seat of carcinoma, I. 117
Schatz's method in face presentation of labour, IV. 141
Schinznach spa, III. 156
Schlangenbad spa, III. 156
Schlatter (Prof.), on results of operations on jaws, II. 117
Schleich's solution for local analgesia, III. 38
Schlösser's method of division of nerves, I. 135
Schnee four-cell bath, I. 747
School children, sleeplessness in, causes of, I. 55
  work, pressure in, to be avoided, I. 8, 9
Schools, diphtheria in, prophylactic use of antitoxin, I. 192
Schroeder's operation in endometritis, IV. 629, 630
Schrötter's hollow vulcanite bougie, III. 865
Schultze's artificial respiration in asphyxia of the newborn child, IV. 352
  pessary in retroflexion of uterus, IV. 680
Schummelbusch's mask in anæsthetics, III. 9, 10
Schwalbach spa, III. 156
Schwartze's operation for opening the mastoid antrum, III. 898
   technique of, III. 898
  post-aural operation in diseases of mastoid process, III. 922, 923
  tenotomes, III. 914
Sciatic arteries, injuries to, I. 1276
  neuritis, old-standing chronic, II. 1125
Sciatica, II. 1123
  acute, II. 1123
  chronic, II. 1125
  complicating diabetes mellitus, I. 426
  hypnotism in case of, III. 170, 171
  in gout and gouty conditions, I. 444
  massage in, III. 210
  mineral waters and baths in, III. 142
  surgical treatment of, II. 1129
Scirrhus, atrophic, of the breast, II. 964
Scissors, long, for enucleation of tonsil, III. 753
Sclavo's anti-anthrax serum, I. 179
Sclerodermia, III. 1139
Sclerosis, amyotrophic lateral, II. 1054
  disseminated, II. 1070-1076
   fibrolysin in, II. 1074
   general treatment, II. 1071
   mercurial inunction in, II. 1072
   prophylaxis of, II. 1071
   special symptoms of, II. 1075
   tonic medicines in, II. 1073
Sclerotomy, posterior, in glaucoma, III. 602
Scoliosis, active movements for the muscles on the convex side in, III. 246
  deformities of the shoulders, and torticollis, I. 972-988
  four-footed exercises for, III. 248
  movements giving equal work to back muscles in, III. 243
   to exercise muscles in, III. 248
   to improve mobility in, III. 242
  physical exercises for, III. 241
  Zander treatment in, III. 372
Scopolamine and morphine, injection of, in labour, IV. 378

Scopolamine (*contd*)—
  (hyoscyamine or hyoscine), poisoning by, I. 532
Scrofuloderma, III. 1152
  X-rays in, III. 352
Scrotum, diseases of, II. 900
  elephantiasis of, III. 504-516
  epithelioma of, II. 900
  filarial lymph, III. 503
  hæmatoma of, II. 900
  wounds of, II. 909
Scurvy and infantile scurvy, curative treatment of, I. 476
    diet in, I. 475
    preventive treatment, I. 475
  in newborn child, IV. 371
Sea-bathing in diseases of the heart, I. 1210
Sea-sickness, II. 395
Seawater, purified, subcutaneous injections of, in marasmus, I. 467
Sebaceous adenomata, I. 109
  cysts, I. 108; III. 1146
    suppuration of, I. 109
    of neck, II. 170
    of the scalp, I. 892
  horns, I. 109
Seborrhœa, III. 1141-1142
  capitis, III. 1141
  X-rays in, III. 359
Seborrhœic dermatitis, III. 1143
Secretions, abnormal, application of vibration in, III. 220
  internal, disorders of, I. 388
    and obesity, I. 468, 472
Sedative baths, III. 125
Sedatives, dosage of, in diseases of children, I. 67
  during accidental hæmorrhage in pregnancy, 24
  in diseases of the heart, I. 1224
  in relief of pain in inoperable cancer, I. 134
Seminal vesicles, final separation of, in carcinoma of the prostate, II. 936
  vesiculitis complicating gonorrhœa, I. 227
Semple on vaccine therapy in typhoid fever, I. 345
Senile alopecia, III. 998
  decay, mineral waters and baths in, III. 145
  endometritis, leucorrhœa in, IV. 570
  gangrene, I. 215
  neuritis, II. 1041, 1139
  vaginitis, leucorrhœa in, IV. 565
  warts, III. 1159
Senn's method for malignant stricture of the œsophagus, II. 180
Senna in constipation in adults, II. 418
Sepsis after amputations, I. 803
  of the cord in newborn child, IV. 370
  puerperal, prevention of, IV. 287-294
Septic cases, management of, I. 92
Septic (*contd.*)—
  infection complicating operation for goître, II. 68
  states in anæmia, II. 16
  wounds, I. 558
Septicæmia and pyæmia, general and local treatment of, I. 295-298
  following compound fractures, I. 581
Sequelæ and complications of disease, I. 22
Sera, administration of, III. 261
Sero-vaccines in infective endocarditis, I. 206
Serum, anti-plague, III. 285
  anti-pneumococcus, III. 285
  antirabic injection in rabies, I. 265
  anti-streptococcus, III. 290
    in pernicious anæmia, II. 8
    in pelvic cellulitis, IV. 833
  anti-tetanic, in tetanus in puerperium, IV. 326
  diphtheritic, dangers and ill-effects of, III. 274
  Dunbar's antitoxic, III. 286-287
  Flexner's anti-meningitis, III. 282
  Moebius's antithyroid, in exophthalmic goître, II. 56
  rabbit, effect on coaguability of blood, I. 129
  sickness in serum therapy, III. 261
  staphylococcus, III. 288
  therapy, administration of sera in, III. 261
    doses, summary of, III. 301
    general principles of, III. 258-270, 260
    horse serum in, III. 261
    in epilepsy, II. 999
    in gonorrhœal arthritis, I. 783
    in infective endocarditis, I. 205
    in purulent meningitis, I. 250
    in pyæmia and septicæmia, I. 297
    in scarlet fever, I. 286
    of acute dysentery, III. 430
    of bacillus coli communis, III. 271
    of cancer, I. 152
    of cholera, III. 273
    of diphtheria, III. 273
    of dysentery, III. 279
    of general paralysis of the insane, II. 1079
    of gonococcus infections, III. 280-281
    of intermittent claudication, II. 1235
    of leprosy, III. 451
    of meningococcus infection, III. 282-283
    of micrococcus catarrhalis infections, III. 283-284
    of peritonitis, II. 637
    of plague, III. 284-285, 407
    of pneumococcus infections, III. 285-286
    of pneumonia, I. 262
    of puerperal sepsis, IV. 308

Serum therapy (*contd.*)—
  of pyorrhœa alveolaris, III. 287
  of rheumatism, acute, I. 272
  of streptococcus infections, III. 289
  of tetanus, I. 329-330
  of tuberculosis, III. 297
  of typhoid fever, I. 345; III. 300
  serum sickness in, III. 261
Sexual function, female disorders of, IV. 839-864
  obesity and, I. 473
  hypochondriasis in impotence, I. 232
  neurasthenia, I. 231
Shattock (S. G.), on lipomatosis, I. 108
Shaving, previous to operation, I. 84-93
Shaw-Mackenzie, on trypsin treatment of cancer, I. 151
Sheep, anthrax amongst, I. 179
Sheets, arrangement of, before and after operation, I. 30
Shellfish, chemical composition of, II. 194
  poisoning, I. 506
Sherren (James), division of posterior roots in neuritis, II. 1035-1133
  infantile paralysis, nerve anastomosis in, II. 1059-1060
  injuries of nerves, II. 1100-1107
  injuries of special nerves, II. 1108-1113
  surgical treatment of neuralgia, II. 1127-1129
  traumatic neuritis, II. 1106-1107
  tumours of nerves, II. 1142
Shock after amputations, I. 803
  after cataract extraction, III. 632
  after ovariotomy, IV. 793
  after radical operation for cancer of the breast, II. 967
  anæsthesia in relation to, I. 95
  and anæsthetics, III. 24
  and collapse, I. 93-105
    bibliography of, I. 105
  causes of, I. 93
  complicating abdominal operations, II. 269
    gynæcological surgery, IV. 491
  due to heat, I. 537
  electric, I. 547
  from accidental hæmorrhage during pregnancy, IV. 26
  from burns and scalds, I. 540, 548
  in abdominal injuries, II. 244
  in emergency cases of abdominal operations, II. 260
  in gunshot wounds, 558
  in injuries of the stomach, II. 283
  in post-partum hæmorrhage, IV. 222
  in severe contusions of the spine, I. 898
  in Wertheim's operation, IV. 607
  position during operation in, I. 95
  preparation of the patient in, I. 95
  prevention of, I. 95
    by strychnia, I. 84
  technique of operation in, I. 96

Shock (*contd.*)—
  treatment of, 96-104
    by drugs, I. 102
    by feeding, I. 103
    by infusion of normal saline, I. 98
    by intra-peritoneal infusion, I. 101
    by intravenous infusion, I. 100
    by rectal infusion, I. 99
    by subcutaneous infusion, I. 99
    by transfusion of human blood, I. 102
Shoulder, congenital elevation of, I. 985
  deformities of, scoliosis and torticollis, I. 972-988
  hot-air apparatus for, III. 322
  operative treatment of tuberculous disease of, I. 770
  tuberculous disease of, I. 775-777
Shoulder-joint, congenital dislocation of, I. 935
  disarticulation of by a racket incision, I. 827
    through, the, I. 827-830
  dislocation, complicating fracture, I. 587
    reduction of, I. 715
Shoulders, round, I. 986
Shrubsall (Frank C.), physical exercises, III. 222-257
Sickness, repeated, in peritonitis, II. 638
Sick-room cookery, I. 42
    and dietary for, I. 42
  duties of the nurse in, I. 27
  fittings and furniture in, I. 26
  hygienic measures in, I. 26, 40
  management of, I. 26-43
    for typhoid fever, I. 338-340
  preparations for operation in, I. 27
Siegel's speculum in massage of tympanic membrane, III. 952
Sigmoid, overloaded condition of, in constipation in children, II. 435
  sinus, thrombosis of, complicating diseases of the ear, III. 941-943
Sigmoidoscope in chronic mucous colitis, II. 570
Silk ligatures, sterilisation of, I. 72
  web œsophageal bougie, II. 172, 173
Silk's celluloid mask, III. 733
Silkworm gut sutures, I. 86
Silver, nitrate of, in diseases of the conjunctiva, III. 548
  in gonorrhœa, I. 223, 227, 229
  in lupus, III. 1150
  wire netting in operation for umbilical hernia, II. 513
Sim's dilator, modification of, IV. 623
Simpson (W. J.), personal and general hygiene in the tropics, III. 375-385
Singer's nodules of the larynx, III. 851
Singing, voice production and, III. 331-340
Sinus, accessory of nose diseases of, III. 716-731
  and fistula, general and local treatment of, I. 299-301

Sinus (*contd.*)—
  ethmoidal, diseases of, III. 727
  formation in tuberculous disease of hip-joint, I. 759
  frontal, diseases of, III. 727-730
  irregularity of the heart, I. 1228
  maxillary, diseases of, III. 721-727
  persistent, of the breast, II. 960
  spenoidal, diseases of, III. 730
Sitting in physical exercises, III. 229
  with legs crossed, exercise for flat foot, III. 235
"**Skewed**" heel for weak foot, I. 968
Skey's modification of Lisfranc's amputation, I. 840
Skin, anthrax of, I. 179
  application of radium to, III. 308
  carcinoma of, secondary growths rare in, I. 125
  care of, in infants, I. 48
    in scarlet fever, I. 288
  cough, in pulmonary tuberculosis, I. 1144
  diseases of, III. 982-1057
    ascribed to vaccination, I. 313
    electro-therapeutics in, III. 110
    gouty, I. 446
    mineral waters and baths in, III. 144
    tropical, III. 470-486
    X-ray treatment of, III. 341-359
  elasticity of, restoration of, I. 69
  epithelioma of, III. 1037-1038
  flaps, in amputations, I. 796
  functions of, modified by X-rays, III. 353
  grafting in burns and scalds, I. 543
    in ulceration, I. 373-375
    in wound contraction, I. 555
  hygiene of, in arterio-sclerosis, I. 1291
  inunction of, value of, I. 70
  Kaposi's disease of, III. 1057
  localised inflammations of X-rays in, III. 349
  myomata of, III. 1057
  preparation of, in abdominal operations, II. 259
    in emergency cases of abdominal operations, II. 260
    in ovariotomy, IV. 775
  protection of, in small-pox, I. 305
  sarcoma of, III. 1037
  scarring of, in acne vulgaris, III. 986
  sterilisation of, I. 27, 557
    before operation, I. 84
  treatment of, in burns and scalds, I. 541
    in typhoid fever, I. 356
  tuberculosis of, X-rays in, III. 353
  tumours of, innocent, III. 1057
Skinner's mask in anæsthetics, III. 9, 10
Skull, actinomycosis of, I. 891
  air-containing tumours of the, I. 896
  bones, diseases of, headache from, II. 1033
  bony tumours of, I. 895
  fractures of, I. 875-878
Skull, fractures of (*contd.*)—
    base of, I. 877
    Cushing's method in, I. 882
    depressed, I. 876
    in infants, I. 886
    in newborn child, IV. 364
    in separation of the upper jaws from, II. 100
  gunshot fractures of, I. 562
  infective lesions of bones of, I. 889-891
  injuries of, I. 875-878
  surgical diseases of, I. 888
  syphilis of, I. 890
  tuberculous osteitis of, I. 889
  tumours of, growing from the bony walls of, I. 894
  vault of, fractures of, I. 876
Sleep, amount required by infants and children, I. 54
  in acute bronchitis, I. 1050, 1052
  in broncho-pneumonia, I. 1069
  in normal puerperium, IV. 264
  in the tropics, III. 379
Sleeping in open-air for children, I. 52
  sickness in the tropics, III. 383
    See also Trypanosomiasis.
  suits for children, I. 45
Sleeplessness. *See* Insomnia.
Smallpox, I. 302-311
  complications of, I. 308-310
  confluent, treatment of, I. 306
  distribution of eruption in, I. 303
  drugs in, I. 308
  general management of, I. 307
  hæmorrhagic, I. 310
  moist applications in, I. 306
  protection of the skin in, I. 305
  protective measures in, I. 302
  quarantine for, I. 310
  vaccination and, 311-314
  varieties of, I. 310
Smith (A. Lionel), abortion, IV. 14-22
  hydramnios, IV. 43-44
  mole, blood or carneous in pregnancy, IV. 59
  mole, hydatidiform or vesicular in pregnancy, IV. 59
Smith (Eustace), food fever, II. 233-241
  hygiene and care of infants and children, I. 44-70
  on treatment of whooping cough, I. 382
Smith (G. F. Darwall), contracted pelvis and labour, IV. 163-175
  precipitate labour, IV. 224
  tonic contraction of the uterus, IV. 248-249
  uterine exhaustion, IV. 250-251
  uterine inertia, IV. 252-255
Smith (L. G. Bellingham), diseases of the female bladder, IV. 875-883
  diseases of the urethra, IV. 868-874
Smith (Maynard), acute abscess, I. 166-172
  burns and scalds, I. 540-544
  cellulitis, I. 181-184
  contusions and hæmatoma, I. 545-546

- **Smith (Maynard)** (*contd.*)—
  - erysipelas, I. 209-211
  - gangrene, I. 214-220
  - lardaceous disease (albuminoid or amyloid degeneration), I. 462
  - septicæmia and pyæmia, I. 295-298
  - sinus and fistula, I. 299-301
  - tuberculous abscess, I. 173-176
  - ulceration, I. 368-375
  - wounds, I. 550-556
- **Smith's** gag in operation for cleft palate, II. 150
  - operation for immature cataract, III. 621
  - **(Stephen)** operation, I. 859-861
- **Smoking**, effect in affections of tongue, II. 135
- **Snare**, aural, III. 901
- **Snow**, carbon dioxide, for nævi, III. 1078
  - in rodent ulcer, I. 115
  - blindness of the conjunctiva, III. 560
- **Soamin** in cancer, I. 149
  - in syphilis, I. 321
  - in trypanosomiasis, III. 420, 421
  - in undefined tropical fevers, III. 411
- **Soap** and water enema, I. 32
  - for acne vulgaris, III. 985
  - suitable for infants, I. 48
- **Socket** (tooth), septic infection of, after extraction, III. 1190
- **Soda**, bicarbonate, in acute gastritis, II. 847
    - in diabetes, I. 423, 425
    - in rheumatism, I. 271, 278
    - to produce alkalinity of urine, I. 410, 418
  - chlorate, dosage of, in children's diseases, I. 67
  - chloride, ionisation with, I. 488
  - citrate of, added to milk in infant feeding, II. 225
  - potassium in trypanosomiasis, III. 421
  - salicylate in diabetes mellitus, I. 424
    - in rheumatism, I. 271, 278
  - sulphate of, in constipation in adults, II. 449
- **Soden** spa, III. 156
- **Soil**, influence of, in rheumatism, I. 484
- **Solanum** carolinense in epilepsy, II. 998
- **Soldiers**, avoidance of sunstroke by, I. 536
- **Soloids**, Burroughs and Wellcome's infusion of, I. 98
- **Solutions** for infusions, I. 98
- **Somatic** tæniasis, III. 521
- **Sound**, reposition by, in retroflexion of the uterus, IV. 677
  - sterilisation of, I. 92
- **Southey's** tubes for dropsy, in diseases of the heart, I. 1244
- **Spa**, choice of, for gout, I. 459
  - treatment in arterio-sclerosis, I. 1291
    - in cholelithiasis, II. 683
    - in chorea, II. 1263
    - in diseases of the heart, I. 1210
    - of chronic rheumatism, I. 491
- **Spa** treatment (*contd.*)—
    - of constipation in adults, II. 465
    - of uterine leucorrhœa, IV. 571
- **Spas**, (Belgium) III. 156
  - for chlorosis, II. 26
  - index of, III. 147-158
- **Spasmodic** diseases, infantile, warm baths in, I. 70
- **Spasms**, II. 1047-1049
  - facial, II. 1047
  - hysterical, II. 1049
  - laryngeal, in adults, III. 840
    - in children, III. 827-830
  - myoclonus, II. 1049
  - of calf muscles, II. 1062
    - in cerebral palsies of infancy, II. 1160
  - of hiccough, II. 1048
  - phonetic, of the larynx, III. 841
  - pyloric, II. 337
  - reflex, in disseminated sclerosis, II. 1075
  - trismus, II. 1048
- **Spasticity** in hemiplegia, II. 1186
  - in myelitis, II. 1217
- **Speaking**, voice production and, III. 331-340
- **Spectacles**, cataract, III. 633
  - dark, in cataract, III. 618
  - for accommodation and refraction of the eyes, III. 542
- **Speech**, defects of, of cerebral origin, II. 1143
  - effect of cleft palate upon, II. 147
  - restoration of, by functional compensation, II. 1147
    - in aphasia, by functional compensation, II. 1147
- **Spence's** method of disarticulation through shoulder-joint, I. 827-830
- **Spencer (Major C. J.)**, gunshot wounds, I. 557-567
- **Spencer's** table, IV. 479
- **Spermatic** cord, diseases of, II. 917
  - encysted hydrocele of, II. 917
  - hæmatoma of, II. 917
- **Sphenoidal** sinuses, III. 730
- **Sphincter** ani, spasmodic construction of in constipation in children, II. 436
- **Spider** nævi, III. 1077
- **Spigelia** anthelmintica in epidemic gangrenous proctitis, III. 437
- **Spina** bifida, I. 912-916
  - age for operation in, I. 915
  - contra-indications to operation in, I. 915
  - excision in, I. 914
  - injection of iodo-glycerin solution in, I. 913
  - of the newborn child, IV. 361
  - palliative treatment of, I. 912
  - pressure in, I. 912
  - simple tapping in, I. 912
  - spontaneous cure in, I. 912
  - strangulation of the sac in, I. 912
- **Spinal** anæsthesia. *See under* Anæsthesia.
  - analgesia, III. 36
  - canal, hæmorrhage into, I. 904

pinal (*contd.*)—
- cord, affections of, II. 1208
  - degeneration of, sub-acute, combined, II. 1083
  - diseases of, II. 1208
    - electro-therapeutics in, III. 108
  - disseminated sclerosis of, II. 1070-1076
  - gummatous meningitis of, II. 1068
  - injuries of, I. 900-911
    - complications in, I. 908-911
  - tumours of, II. 1221-1225
      - medicinal treatment, II. 1222
    - operation in, II. 1223
- paralysis, deformities due to I. 988-990
- paraplegia, II. 1196

Spine, abscess in connection with tuberculous disease of, I. 928, 932
- actinomycosis of, I. 919
- caries of, I. 922-927
- concussion of I. 899
- counter-irritation in rheumatoid arthritis, I. 405-407
- curvature of, application of vibration in, III. 220
  - lateral, I. 972
  - physical exercises for, III. 236
  - rotate-lateral, I. 972
- deformities of, in children, I. 56
- dislocations and fracture-dislocations of, I. 902
- gunshot wounds of, I. 563, 902
- hydatid disease of, I. 918
- injuries of, I. 898-911
  - concussion, I. 899
  - contusions, I. 898
  - dislocations, I. 902
  - fracture-dislocations, I. 903
  - non-operative treatment, I. 907-911
  - operative treatment of, I. 905, 907
  - severe, non-operative treatment of, I. 907, 911
    - operative treatment of, I. 905, 907
  - wounds of, I. 901
- new growths of, I. 919-920
- sprains of, I. 900
- syphilis of, I. 917-918
- tuberculous disease of, ambulatory treatment of, I. 924
  - paraplegia in, I. 926-927
  - summary, I. 925
  - treatment by recumbency, I. 923
- tumours of, I. 919

Spirits, effect on the tongue, II. 135, 138
- in gouty conditions, I. 456

Spitta (Harold), anthrax, I. 179, 180
- bacillus coli communis, infections of, III. 271-275
- cholera, III. 273
- disinfection, I. 161-165
- dysentry, III. 279-280
- glanders, I. 221-222
- gonococcus infections, III. 280-281
- pollantin (Dunbar antitoxic serum), III. 286-287

Spitta (Harold) (*contd.*)—
- pyorrhœa alveolaris (Rigg's disease), III. 287-288
- rabies, I. 264-265
- streptococcus infections, vaccine therapy of, III. 289-291
- tetanus, I. 329-331

Spleen, abscess of, II. 81
- contusions of, II. 79
- cysts of, II. 81
- diseases of, II. 81-84
- embolism of, I. 1307
- enlarged, chronic polycythæmia with cyanosis and, II. 84
- injuries of, II. 79-80, 251
- laceration of, II. 79
- malarial, II. 81
- removal of in leukæmia, II. 41
- sarcoma of, II. 81
- surgical treatment of, II. 83
- wandering, II. 81
- X-rays in, II. 82

Spleno-medullary leukæmia, II. 38
- complicating pregnancy, IV. 55

Splenomegaly, II. 82-83
- general treatment of, II. 82
- medicinal treatment of, II. 82

Splint sore, I. 572

Splints, abduction, and pad for the shoulder, I. 776
- adjustable, for the knee, I. 769
  - for the wrist, I. 779
- back and side, I. 630
  - for fractures of tibia, I. 625, 627
- Bavarian, I. 574
- Bryant's, I. 617
- Carr's, I. 603
- complicated, in fractures of the jaws, II. 102
- Croft's, I. 574, 629
- Dupuytren's, I. 630
- for fractures of lower jaw, II. 101
- for gunshot fractures, I. 561
- for paralytic dropped wrist, I. 992
- for prevention of claw hand, II. 1014
- forms of, for fractures, I. 572
- fraction, in tuberculous disease of the hip-joint, I. 765
- Gooch's, I. 573
- hallus valgus or rigidus, I. 966
- Hodgen's, I. 614
- in fractures of jaws, II. 114
- in rickets, I. 481
- internal angular for the arm and forearm in fractures, I. 593
- leather, for the knee, I. 766
- Liston's, I. 617
  - in hip-joint disease, I. 754, 762
- MacIntyre's, I. 618
- measurements of, I. 575
- metal, I. 574
  - suspension, for the ankle, I. 773
- plaster of Paris, I. 628
- posterior moulded, for the elbow, I. 600
- Roughton's, I. 630

Splints (*contd.*)—
  Thomas's caliper, I. 767
    hip, I. 756, 765
Spondylitis deformans, I. 404
  syphilitic, I. 917
Spondylolisthetic pelvis complicating labour, IV. 173
Spondylotomy, dangers of, IV. 451
  in labour, IV. 451
Sponging, cold, in typhoid fever, I. 350
  for young children, I. 47
  methods of, I. 37
Sporotrichosis, III. 1143
Sprains, I. 737-740
  electro-therapeutics in, III. 109
  massage in, I. 737, 740; III. 207
  of the spine, I. 900
  weight-extension in, I. 742
Spray chambers in emphysema, I. 1086
Spraying, disinfection by, I. 163
Sprays in asthma, I. 1040
Sprengel's deformity, I. 985
Spriggs (**E. I.**), diabetes insipidus, I. 428-429
  diabetes mellitus, I. 408-427
  infant feeding, II. 214-232
  marasmus, I. 463
  principles of dietetics, II. 190-213
Spring catarrh of the conjunctiva, III. 560
Springs, mineralisation of, III. 114
Sprue, III. 442-446
  complications of, III. 445
  convalescence in, III. 445
  fruit in, III. 443
  local treatment in, III. 445
  meat diet in, III. 443
  medicinal treatment of, III. 444
  milk diet in, III. 442
  soured milk in, III. 443
Squill, oxymel of, in laryngitis, I. 245
Squills in diseases of the heart, I. 1223
Stab-wound over stomach region, II. 282
Stacke's post-aural operation in diseases of mastoid process, III. 922, 923, 926
Stammering, III. 327-330
Standing in physical exercises, III. 229
Stapes, removal of, in chronic inflammation of middle ear, III. 916
Staphylococcus infections, vaccine therapy of, I. 182; III. 288
  peritonitis, II. 641
  serum, III. 288
Starch diet, effect on young children, I. 58, 61
  foods in gout, I. 453
    without, in infant feeding, II. 229
  -free flour, I. 421
  in food, effect on diabetes, I. 411
  poultice, I. 34
Starches, chemical composition of, II. 195
Starvation in pernicious vomiting of pregnancy, IV. 62
  predisposes to shock, I. 95
  treatment in acute gastritis, II. 346
Statical treatment, III. 106
Status epilepticus, II. 1004
  lymphaticus and anæsthetics, III. 25
Steam, disinfection by means of, I. 162
  kettle and tent, I. 39
    in broncho-pneumonia, I. 1067
  pressure, disinfection by, I. 162
  tents in diphtheria, I. 192, 194
Steel plate, use of, in operative treatment of fractures, I. 644
Stegomyia calopus and yellow fever, III. 382
Stellate nævi, III. 1077
Stephens (**G. A.**), on lead colic, I. 513
Sterilisation in cæsarean section, IV. 394, 396
  in gynæcological operations, IV. 483
  of instruments, methods of, I. 72
  of surgical dressings, I. 75-77
  preparatory to operation, methods of, I. 27-30
Sterilisers, preparation of, I. 28-30
Sterility, dilatation of cervix in, IV. 854
  electricity in, IV. 857
  epididymitis causing, I. 227
  female, marriage and, IV. 843
    pelvic examination in, IV. 851
    voluntary, IV. 844
  from discharge from vagina, IV. 852
  in azoöspermia, IV. 849
  in caruncle of female urethra, IV. 852
  in diseases of the ovary, IV. 846
  in endometritis, IV. 845
  in general diseases, IV. 847
  in inflammation of Fallopian tubes, IV. 845
  in man, IV. 848
    treatment of, IV. 850
  in metritis, IV. 845
  in spasmodic dysmenorrhœa, IV. 847
  in the female, IV. 843-859
  lacerated cervix in, IV. 857
  organo-therapy in, IV. 854
  removal of Fallopian tubes and, IV. 856
  retroflexion of uterus in, IV. 856
  vaginal discharge in, IV. 845
Sterno-mastoid, hæmatoma of, in new-born child, IV. 365
Sternum, inflammation of, I. 1032-1033
  syphilis of, I. 1032
  tuberculous disease of, I. 1032
Stevens (**Thos. G.**), hæmorrhoids in pregnancy, IV. 42
  pendulous belly in pregnancy, IV. 61
  pernicious vomiting of pregnancy, IV. 62-64
  prolapse of the pregnant uterus, IV. 70
  prolapse of the vagina in pregnancy, IV. 71
  pruritus vulvæ in pregnancy, IV. 72-73
  retroflexion of the pregnant uterus in pregnancy, IV. 74-75
  syphilis in pregnancy, IV. 76-77
  varicose veins in pregnancy, IV. 89-90
Stewart (**Purves**), alcoholism, I. 495-502

- **Stewart (Purves)** (*contd.*)—
  - lumbar puncture, II. 1025-1026
  - paralysis agitans, II. 1269-1270
- **Stewart (T. Grainger)**, cerebral embolism, II. 1167
  - cerebral hæmorrhage, II. 1168-1176
  - cerebral thrombosis, II. 1179-1180
  - coma, II. 982-985
  - medical treatment of tumours of the brain, II. 1200-1203
  - multiple neuritis, II. 1134-1139
  - neuritis, II. 1130-1132
- **Stiles (Harold J.)**, intussusception, II. 541-549
- **Still's** organism in basilar meningitis, I. 254
- **Stimson's** method in dislocations, I. 725
- **Stimulants**, contra-indicated in shock, I. 97
  - in acute bronchitis, I. 1051
  - in blackwater fever, III. 389
  - in chronic bronchitis, I. 1055
  - in pericarditis, I. 1180
  - in peritonitis, II. 638
  - in plague, III. 403
  - in typhoid fever, I. 344
  - in typhus fever, I. 367
  - use of, in diphtheria, I. 193
    - in fevers, directions for, I. 158
- **Stitch** sinuses complicating gynæcological surgery, IV. 495
- **Stitches**, removal of, after abdominal operations, II. 267
- **Stockings** for young children, necessity of, I. 51
- **Stokes's** supracondyloid amputation, I. 863
- **Stomach**, achylia of, II. 368
  - acidity in disordered digestion in, II. 370
  - atonic dyspepsia of, II. 286
  - atony of, II. 286-292
    - baths in, II. 289
    - climate in, II. 289
    - diet in, II. 289
    - electricity in, II. 288
    - general treatment in, II. 287
    - lavage in, II. 288
    - medicinal treatment in, II. 290
    - prophylaxis of, II. 286
  - atrophy of (achylia), II. 293-295
    - from chronic gastritis, II. 294
    - from ingestion of corrosives, II. 294
    - general treatment in, II. 293
    - with pernicious anæmia, II. 293
  - cancer of, II. 296-301
    - acidity in, II. 300
    - anorexia and, II. 298
    - constipation in, II. 300
    - diet in, II. 297
    - general treatment of, II. 296
    - hæmatemesis in, II. 300
    - jejunostomy for, II. 305
    - lavage in, II. 296
    - medicinal treatment of, II. 298
    - mortality from, II. 302
- **Stomach**, cancer of (*contd.*)—
    - pain in, II. 299
    - partial gastrectomy for, II. 308
    - radical operation for, II. 308
    - relief of obstruction in, I. 139, 140
    - surgical treatment of, II. 302-309
    - symptomatic treatment of, II. 298
    - vomiting and, II. 299
  - cardiospasm of, II. 357
  - catarrh of, diet in, II. 209
  - colic fistulæ of, II. 490
  - concretions of, II. 359
  - contraction of, II, 334-336
    - partial gastrectomy for, II. 336
    - perigastritis complicating, II. 336
  - cough in pulmonary tuberculosis, I. 1146
  - crisis of, in tabes dorsalis, II. 1090
  - descent of total, II. 319
  - dilatation of, II. 310-311
    - acute post-operative, II. 311
    - chronic, diet in, II. 313
      - general treatment of, II. 312
      - lavage in, II. 312
      - medicinal treatment of, II. 314
      - pyloric stenosis, II. 312
    - in pulmonary tuberculosis, I. 1150
    - obstructive, II. 316
  - diseases of, diet in, II. 209
  - displacements of, II. 318-322
    - upward, II. 318
    - vertical, II. 318
  - distension of, complicating abdominal operations, II. 270
  - electrical treatment of, II. 355
  - examination of, in epilepsy, II. 992
  - external injuries associated with wound of, II. 282
  - flatulence in disordered digestion in, II. 371
  - foreign bodies in, II. 285
    - gastrotomy for, II. 285
  - gunshot injuries of, II. 283
  - habitual regurgitation of, II. 357
  - hæmorrhage from, II. 325-330
    - acute gastric ulcer and, II. 325
    - in cancer, II. 329
    - in hepatic cirrhosis, II. 329
  - hour-glass, II. 334
  - hyperacidity of, II. 360
  - hypersecretion of, II. 364-365
    - medicinal treatment of, II. 367
  - inflammations of. *See* Gastritis.
  - injuries of, II. 282-285
    - caused by blow, II. 283
      - by kick, II. 283
    - due to swallowing caustic fluids, II. 284
    - puncture from within in, II. 284
    - rupture from within in, II. 284
    - without external wound, II. 283
  - lavage of, in acute alcoholism, I. 495
    - in acute catarrh, I. 506
    - in poisoning, I. 528
  - motor insufficiency of, II. 209

Stomach (*contd.*)—
  nausea in disordered digestion in, II. 373
  nervous diseases of, II. 354-358
    eructation of, II. 357
  neurasthenia of, II. 354
  operations upon, food before, II. 259
  pain in disordered digestion in, II. 373
  parasitis of, II. 359
  region, stab-wound over, II. 282
  rupture of, within, II. 284
  secretory disorders of, II. 360-369
    diet in, II. 361
    lavage in, II. 361
    medicinal treatment of, II. 363
  symptoms of disordered digestion in, II. 370-374
  tetany of, II. 399
  tumours of, simple, II. 400
  ulcer of, II. 375-381
    acute, II. 325, 382
    chronic, II. 382
    simple, II. 327
    complications of, II. 380
    constipation in, II. 381
    diet in, II. 210, 376
    gastro-enterostomy in, II. 386
    general treatment, II. 375
    medicinal treatment of, II. 378
    pain in, II. 381
    perforated, II. 389
    preceding cancer, I. 119
    prophylaxis of, II. 375
    pyloroplasty in, II. 385
    surgical treatment, II. 382-388
    symptoms of, II. 381
    tetany in, II. 381
    vomiting in, II. 380
  volvulus of, II. 400
  vomiting in disordered digestion in, II. 373
  water-rash in disordered digestion in, II. 374
Stomatitis, II. 120-125
  aphthous, II. 120-121
    food administration in, II. 121
    general treatment of, II. 121
    local treatment of, II. 120
    prophylaxis of, II. 120
  catarrhal, II. 120
  follicular, III. 1192
  gangrenous, II. 124-125
  in measles, I. 246
  mercurial, II. 125
    prophylaxis of, II. 125
    treatment of, II. 125
  parasitic, prophylaxis of, II. 122
  (thrush), II. 122-124
    treatment of, II. 123
  recurrent, II. 122
  ulcerative, II. 121-122 ; III. 1192
    chronic, III. 1192
    complicating scarlet fever, I. 293
    diet in, II. 122
    general hygiene in, II. 122
Stomatitis, ulcerative (*contd.*)—
    local treatment of, II. 121
    prophylaxis of, II. 121
Stools, characteristics of, infant feeding and, II. 231
  disinfection of, I. 40, 164
  examination of, I. 510
Stoppany's plate for fracture of the jaws, II. 114
Stovaine, injection of, for spinal analgesia, III. 37
Strabismus, III. 651
  convergent, III. 651
  divergent, III. 654
  operative treatment, III. 653
  vertical, III. 655
Strain caused by excessive exercise, I. 8
Stramonium, poisoning by, I. 532
Strapping in fractures of clavicle, I. 584
Strathpeffer spa, III. 156
Strawberries, idiosyncrasy to, I. 454
Streptococcus angina, III. 771
  directions for isolating, III. 289
  in infective endocarditis, I. 203
  in salpingitis, IV. 815
  infectious, vaccine therapy of, I. 182; III. 289-291
  meningitis, I. 250
  peritonitis, II. 641
Streptothrix infection, I. 177
  leproides in leprosy, III. 452
Stretch in physical exercises, III. 230
Stretching movements for scoliosis, III. 244
Strophanthus, in diseases of the heart, I. 1222
Strophulus, in newborn child, IV. 371
Strychnine, contra-indicated in shock, I. 97
  in alcoholism, I. 501
  in beri-beri, III. 415
  in chronic congestion of the lungs, I. 1079
  in constipation in adults, II. 446
  in diseases of the heart, I. 1227
  in epilepsy, II. 998
  in heart failure, I. 193, 200
  in infantile debility, I. 66
  in pellagra, I. 522
  in pneumonia, I. 260
  in poisoning, I. 527, 531, 533
  injection of, in dangers arising during anæsthesia, III. 33
  prevention of shock by, I. 84
Stupes and fomentations, I. 35
Styptics in hæmophilia, II. 32
  in hæmorrhage, I. 1261
Sub-thermal baths, III. 125
Subastragaloid disarticulation, Farabœuf's, I. 843
Subclavian aneurysm, I. 1304
  artery, hæmorrhage from, I. 1275
Subcutaneous infusion in shock, I. 99
Sublingual abscess and affections of the tongue, II. 133
  glands, inflammation of, II. 158

Submaxillary glands, inflammation of, II. 158
  tumours of, II. 162
Subphrenic abscess, II. 643-644
Suction-apparatus for hyperæmic treatment, III. 56-60
Sugar in diet for gout, I. 453
  in urine in diabetes, quantities of, I. 410
  milk diluted with, II. 223
Suggestion in hysteria, II. 1009
  in nocturnal enuresis, II. 76
  treatment by, III. 159-179
Sulphated purgative waters, III. 121
Sulphonal in diseases of the heart, I. 1225
  in insomnia, II. 991, 1023
  poisoning by, I. 531
Sulphur baths, III. 133
  in boils, III. 1007
  in chlorosis, II, 27
  in osteo-arthritis, I. 401
  waters, III. 117
Sulphuretted hydrogen poisoning, I. 534
Sulphurous acid in typhoid fever, I. 355
Sulphurous acid gas, use of, for fumigation, I. 162
Sun in tropics, precautions when exposed to, III. 377
Sunderland (Septimus), leucorrhœa, IV. 555-574
Sunshine in chlorosis, II. 20
Sunstroke, preventive treatment of, I. 536-537
  sequelæ of, I. 538-539
Suppositories, glycerine, in constipation in adults, II. 453
  in constipation in adults, II. 452
Suppuration, acute, in disease of the hip-joint, I. 763
  complicating wound after abdominal operation, II. 273
  following compound fractures, I. 582
  in pelvic cellulitis, IV. 828
  in tuberculous disease of the knee-joint, I. 768
  pelvic, I. 917
  prolonged, disease of the hip-joint, I. 765
Supracondyloid amputation through thigh, I. 862
Supramalleolar amputation (Guyon), I. 850
Supra-orbital neuralgia, II. 1115
  notch, alcohol injection into, for neuralgia, II. 1117
Suprapubic drainage in carcinoma of the prostate, II. 939
  fistula, failure of closure of, complicating adenoma of the prostate, II. 945
  prostatectomy in adenoma of the prostate, II. 942
Suprarenal extract in hæmatemesis, II. 300
Suture of arteries for injury to I. 1279
Surgeon, antiseptic precautions for, I. 80
Surgery, antiseptic methods of, I. 84-92
  gynæcological, after-treatment of, IV. 487-489
  operative, technique of, I. 71-92
  radium therapy, combined with, III. 313
  technique, operation room, I. 71-74
    preparation of instruments, I. 30
      of patient, I. 27, 83-87
      of room, I. 28, 71
      of special regions, I. 87-91
    septic cases, I. 92
    surgeon and assistants, I. 80-83
    surgical dressings, I. 74-80
Sutherland (G. A.), colic in children, II. 428-431
  constipation in children, II. 432-438
  diarrhœal diseases in children, II. 471-478
  scurvy and infantile scurvy, I. 475-477
Sutures in ovariotomy, IV. 776
  methods of, in wounds, I. 553
  sterilisation of, I. 72
Swabs in gynæcological operations, IV. 483
Swayne (Walter Charles), pelvic cellulitis, IV. 824-838
Sweat glands, adenoma of, III. 1044
  hydradenomata of, III. 1044
Sweating, coloured, or chromidrosis, III. 1021
  excessive, III. 1044-1045
  in pulmonary tuberculosis, I. 1143
Swedish gymnastics in constipation in adults, II. 459, 460
Sweep's eczema, I. 117
Switzerland, Föhn wind of, III. 75
Sycosis, III. 1144-1145
  X-rays in, III. 350
Sydenham on small-pox, I. 302
Symblepharon of the conjunctiva, III. 548
Syme's disarticulation at the ankle-joint, I. 845
  operation, comments on, I. 848
    incisions in, I. 845
Symonds' short œsophageal tube, II. 175
    with terminal opening, II. 176
  short tube, special form of, introducer for, II. 176
Symphysiotomy, IV. 452-460
  anatomy of, IV. 454
  child alive and at term in, IV. 453
  dangers to patient in, IV. 459
  in contracted pelvis, complicating labour, IV. 171
  injuries to soft parts in, IV. 460
  limits of operation in, IV. 453
  mortality of, IV. 459
  open method of, IV. 457
  operation of, IV. 456
  pelvis greatly deformed and, IV. 454
  Pinard's register for, IV. 457
  prognosis in, IV. 459
  repeated, IV. 460

Symphysiotomy (*contd.*)—
  results of, IV. 459
    division of symphysis in, IV. 452
  separation of bones in, IV. 453
  subcutaneous, IV. 458
Symphysiotomy knife, Galbiati's, IV. 457
Symphysis, division of, results of, IV. 452
Symptomatic treatment, I. 18
Syncope in placenta prævia, IV. 69
Syndactyly or webbed fingers, I. 943
Synechia of the nose, III. 672
Synovial disease, primary, of the ankle and tarsus, I. 772
  effusion in tuberculous disease of the knee-joint, I. 767
Synovitis, I. 483
  acute, I. 741-742
    deformity of, I. 742
    or sub-acute in gonorrhœal arthritis, I. 781
  chronic, I. 745-748
    ionic medication of, III. 185
  electro-therapeutics in, I. 746
  fibrolysin in, I. 748
  hydro-therapeutics in, I. 745
  local applications in, I. 748
  scarlatinal, I. 290
  teno-acute, suppurative, I. 170
  tuberculous, I. 752
Syphilis, I. 316-324
  and anæmia, II. 17
  and aphasia, II. 1144
  arsenic in, I. 321
  aryl-arsonate groups in, I. 321
  bursitis in, II. 1335
  calomel in, I. 318
  cerebral, headache from, II. 1034
    thrombosis in, II. 1069
  cerebro-spinal, II. 1063-1069
    anti-syphilitic therapy, II. 1065
    arsenic in, II. 1067
    intracranial gumma in, II. 1067
    iodides in, II. 1065
    mercury in, II. 1065
    prophylaxis of, II. 1063
    cirrhosis of the liver in, II. 665
  clinical pathology of, in relation to treatment, I. 325-328
  complicating pregnancy, IV. 76-77
    pulmonary tuberculosis, I. 1156
  congenital, in newborn child, IV. 369
    jaundice and, II. 672
  constitutional treatment of, I. 316
  cranial, I. 890
  drugs in, I. 317, 319, 324
  fœtal, complicating pregnancy, IV. 77
  grey oil injections in, I. 319
  hectine in, I. 323
  hygiene of the mouth in, I. 318
  intramuscular injections in, I. 318
  intravenous injections in, I. 320, 322
  inunctions in, I. 319
  iodine in, I. 321
  iritis in, III. 588
Syphilis (*contd.*)—
  mercury in treatment of, I. 317
  mineral waters and baths in, III. 143
  myositis in, II. 1324
  neuritis in, II. 1130
  of bones, I. 703
  of joints, I. 784
  of the internal ear, III. 978
  of the larynx, III. 868-869
  of the meatus, III. 883
  of the naso-pharynx, III. 743
  of the nose, III. 714-715
  of the pharynx, III. 791-792
  of the prostate, II. 927
  of the ribs and sternum, I. 1032
  of the spine, I. 917-918
  of the testis, II. 907
  of the tongue, II. 134-137
  of the tonsil, III. 756
  of the vulva, IV. 520-521
  paralysis in, II. 1069
  salvarsan ("606") in, I. 322 ; II. 1144
  sarsaparilla in, I. 323
  tenosynovitis in, II. 1330
  Wassermann reaction in, I. 325
Syphilitic onychitis, III. 1082
  phlebitis, I. 1330
  vascular disease, cerebral thrombosis due to, II. 1177
Syringe, Blake's tympanic, III. 912
  Neumann's, III. 913
Syringomyelia, II. 1219-1220
  arthritis in, I. 786
  Röntgen rays in, II. 1219

Tabes dorsalis, II. 1085-1092
  electricity in, II. 1091
  fibrolysin, II. 1086
  Fraenkel's exercises in, II. 1091
  gastric crises in, II. 1090
  hydropathy in, II. 1092
  iodide of potassium in, II. 1087
  massage in, II. 1091
  medicinal remedies in, II. 1088
  mercury in, II. 1086
  salvarsan in, II. 1088
  sphincter of bladder troublesome in, II. 1090
Tachycardia, I. 1235
  and anæsthetics, III, 23
  in the menopause, IV. 502
  paroxysmal, I. 1236
Tæniasis, intestinal, III. 517-520
  anthelmintic treatment of, III. 518
  preparatory treatment in, III. 518
  prophylaxis of, III. 517
  purgative treatment of, III. 518
  somatic, III. 521
  visceral, III. 521
Takadiastase in gouty dyspepsia, I. 442
Talipes equino-varus, I. 952, 953
  in newborn child, IV. 362
  physical exercises for, III. 233

Tampons in puerperal vaginitis, IV. 563
wool, in retroversion of the uterus, IV. 674
Tannin in hæmorrhage, I. 1261
Tapotement and massage, III. 204
Tapping, in pleural effusion, I. 1095-1097
in spina-bifida, I. 902
Tar, Barbados, in water itch, III. 486
in pruritus, III. 1099
in psoriasis, III. 1119
workers' dermatitis, III. 1030
Tarasp-Schuls spa, III. 156
Tarsal bones, fractures of, I. 632-633
Tarsus, disease of, I. 773
operations on, in congenital club-foot, I. 957
tuberculous disease of, I. 772-775
Tartar emetic in trypanosomiasis, III. 421
Taylor (Ames), psychasthenia, II. 1044-1046
Taylor (E. H.), amputations, I. 789-872
Taylor (Gordon), hæmorrhage and injuries of arteries, I. 1255-1277
surgical diseases of arterio-sclerosis, I. 1296
wounds of arteries, I. 1278-1280
Taylor (James), neurasthenia, II. 1038-1043
Tea in typhoid fever, I. 343
Teale's amputation, I. 851
Teeth, abnormalities of position of, III. 1165
artificial, cleansing of, II. 128
care of, II. 127
in children, I. 49
in cleft palate operation, II. 152
in scarlet fever, I. 294
in sprue, III. 445
in syphilis, I. 318
caries of, III. 1172
cleaner, rubber, II. 128
crowns of, artificial, III. 1178
dislocation of, III. 1177
displacement of in fracture of the jaw, II. 99
examination of in epilepsy, II. 992
extraction of, III. 1179
anæsthetics for, III. 29
casualties in, III. 1188
complications, III. 1188
hæmorrhage following, III. 1189
local anæsthetics and, III. 1190
methods applicable to individual teeth, III. 1181-1188
septic infection of socket following, III. 1190
under anæsthetics, III. 1190
fracture of, III. 1177
necrosis of jaw and, II. 108
pulp of, diseases of, III. 1173
temporary, extraction of, III. 1188
ulcer in tuberculous disease of the tongue, II. 133
Telegraphist's cramp, II. 1266
Telephone ear, III. 880
Telling (W. H. Maxwell), actinomycosis, I. 177
erythema nodosum, I. 212-213
Glenard's disease (enteroptosis), I. 430
rheumatism in childhood, I. 276-279
Temperance, general, a principle of treatment, I. 9
Temperature (body) in blackwater fever, III. 388
in infectious diseases, I. 159, 160
in non-operative appendicitis, II. 424
in sanatorium treatment of tuberculosis, I. 1132
in tuberculin therapy, I. 1141
in typhoid fever, I. 348
methods of reduction of, I. 36
persistent, complicating acute rheumatism, I. 272
reduction of, by baths, I. 69
effect of the mind on, I. 1141
gastro-intestinal in pulmonary tuberculosis, I. 1139
in gynæcological surgery, IV. 487
in normal puerperium, IV. 261
in sanatorium treatment of pulmonary tuberculosis, I. 1131, 1135
increase of in pulmonary tuberculosis, I. 1140
post-hæmorrhagic rise of, I. 1141
changes of, children require protection from, I. 50
of baths and packs, I. 36, 38
of nurseries, regulation of, I. 44
Temporo-maxillary joint, inflammatory diseases of, II. 105
injuries of, II. 104
sphenoidal abscess complicating diseases of the ear, III. 939
Tendo Achillis, rupture of, II. 1328
Tendon sheaths, affections of, II. 1330-1333
ganglion of, II. 1332
excision in, II. 1332
puncture in, II. 1332
infection of, I. 169
tumours in connection with, II. 1331
Tendons, diseases of, II. 1326-1333
dislocation of, II. 1326
division of, II. 1326
injuries of, dropped finger in, II. 1329
rupture of, subcutaneous, II. 1328
stiff and painful action of in fractures, I. 578
wounds of, II. 1326-1329
Tenonitis of the orbit, III. 662
Tenosynovitis, acute septic, II. 1330
simple, II. 1330
chronic simple, II. 1330
massage in, III. 209
suppurative, I. 169
syphilitic, II. 1330
tuberculous, II. 1331
caseation in, II. 1331
early stages of, II. 1331

- **Tenotomes**, Schwartz's, III. 914
- **Tenotomy** of the plantar fascia in congenital club-foot, I. 954
- **Tent** and steam kettle, I. 39
- **Teplitz** spa, III. 156
- **Terminations** of disease, aspects of, I. 21
- **Testis**, diseases of, II. 901
  - ectopia of, II. 904
  - enucleation of, in operation for elephantiasis scroti, III. 507
  - hernia of, II. 901
  - imperfect descent of, II. 902-905
  - inflammation of, II. 906
  - non-descent of, in newborn child, IV. 360
  - syphilitic disease of, II. 907
  - torsion of, II. 907
  - tuberculous disease of, II. 908-909
  - tumours of, II. 910
  - wounds of, II. 907
    - penetrating, II. 907
- **Tetanic** rupture of rectus abdominalis, II. 249
- **Tetanus**, I. 329-331
  - complicating the puerperium, IV. 326-327
  - incubation period of, I. 329
  - local treatment of wound in, I. 329
  - means of infection in, I. 329
  - medicinal treatment of, I. 330
  - methods of examination in, I. 329
  - prophylactic treatment with anti-tetanic serum, I. 330
  - serum therapy of, I. 329
- **Tetany**, II. 1271
  - complicating pregnancy, IV. 51
    - the puerperium, IV. 328
    - ulcer of the stomach, II. 381
  - gastric, I. 388
  - in children, II. 1272-1273
  - of the stomach, II. 399
- **Tetronal**, poisoning by, I. 531
- **Thecal** whitlow, I. 169
- **Theocin** in œdema, I. 422
- **Theocin-sodium** acetate in chlorosis, II. 27
- **Theophyllin** in œdema, I. 422
- **Therapeutic** procedure, diagnosis to precede, I. 23
- **Therapeutics**, principles of, I. 1-25
- **Thermal** baths, III. 124, 126
  - mineral waters, III. 116
  - or hot douche bath, III. 127
- **Thermo-cautery**, use of, in operable cancer, I. 137
- **Thermometers**, use of, in baths and packs, I. 36, 38
- **Thiersch** grafts in cheloid, I. 113
    - in tropical phagedena, III. 473
    - value of, I. 118
  - method of skin grafting, I. 543
  - skin grafts, I. 374
- **Thigh**, amputations through, I. 862-866
  - by a long anterior flap, I. 864
- **Thiosinamin** in cheloid, III. 1018
- **Thirst** after abdominal operations, II. 263
  - in cholera, III. 426
  - in diabetes, I. 417
- **Thomas'** abduction frame, II. 1061, 1159
  - caliper splint, I. 767
  - (Guillard) operation for fibro-adenomata of the breast, II. 956
  - hip splint, I. 756, 765
  - in tuberculous disease of hip-joint, I. 765
  - wrench in congenital club-foot, I. 955
- **Thomson (H. Campbell)**, hysteria, II. 1008-1013
- **Thomson (J. C.)**, plague, III. 401-409
- **Thomson's (St. Clair)** post-nasal forceps, III. 734
- **Thoracic** aorta, surgery of, in aneurysm, I. 1303
  - nerve, posterior, injuries of, II. 1112
  - wall, new growths of, I. 1034
    - osteomyelitis of, I. 1032
- **Thoracopagus**, podalic version in, IV. 468
- **Thoracoplasty** in empyema, I. 1107
- **Thorax.** *See* Chest.
- **Thorburn (William)**, injuries and diseases of the spine, I. 898-911
- **Throat**, care of, in scarlet fever, I. 284
  - coughs in pulmonary tuberculosis, I. 1145
  - cut, II. 164
    - after-treatment of, II. 165
    - complications of, II. 165
    - sequelæ of, ii. 166
  - gouty affections of, III. 775
  - rheumatic affections of, III. 764
  - sore, complicating influenza, I. 239
    - swabbing of, in diphtheria, I. 194
- **Thrombic** obstruction in injuries of arteries, I. 1278
- **Thrombosis** after ovariotomy, IV. 794
  - and phlebitis, I. 1328-1338
  - arterial, I. 1337
  - cerebral, II. 1177-1180
    - due to abnormal blood states, II. 1179
    - circulatory enfeeblement, II. 1178
    - obstruction by pressure from without, II. 1179
    - senile arterial changes, II. 1178
    - syphilitic, II. 1069
    - vascular disease and, II. 1177
      - associated with renal disease, II. 1178
    - treatment of, II. 1179
  - chlorotic, I. 1331
  - complicating abdominal operations, II. 274
  - femoral, complicating gynæcological surgery, IV. 494
    - in puerperal sepsis, IV. 321
  - gangrene due to sudden obliteration of arteries by, I. 215
  - of corpus cavernosum, I. 1331
  - of the orbit, III. 662

Thrombosis (*contd.*)--
  of portal vein, I. 1331 ; II. 666-667
  of prostatic veins, I. 1331
  of retinal veins, III. 614
  of sigmoid sinus, complicating diseases of the ear, III. 941-943
  of the veins of broad ligaments, IV. 822-823
  prophylaxis of, after abdominal operations, II. 274
  treatment of, after abdominal operations, II. 274
  venous, complicating typhoid fever, I. 360
Thrombus in varicose veins, I. 1331 ; IV. 89
Thrush, II. 122-124 ; III. 792
Thumb, amputation of, I. 811
  congenital lateral deviation of the phalanges of, I. 938
Thymol in typhoid fever, I. 355
  treatment of ankylostomiasis, III. 490
Thymus extract in cancer, I. 150
Thyro-glossal cysts of neck, II. 170
  fistula, II. 167-170
Thyro-hyoid cyst of neck, II. 168
  space, injury to in cut throat, II. 164
Thyroid arteries, ligature, in exophthalmic goître, II. 59
  cysts of neck, II. 170
  extract, administration of. II. 49-50
    in cancer, I. 150
    in eclampsia, IV. 37
    in goître, II. 62
    in lipomatosis, I. 108
    in nocturnal enuresis, II. 76
    in obesity, I. 473
    in osteo-arthritis, I. 402
    in psoriasis, III. 1114
  fistulæ of neck, II. 167
  gland, changes in, psychoses associated with, II. 1301-1302
    congestion of, II. 51
    diseases of, II. 49-74
    enucleation of, in goître, II. 64
    extirpation of, in goître, II. 63
    hypertrophy of, II. 51
    inflammation of, II. 51
    influence on obesity, I. 473
  growths of, respiratory obstruction due to, I. 142
  inadequacy, II. 78
  inflammation of, acute, II. 52
    chronic, II. 53
    surgical treatment of, II. 53
  malignant disease of, II. 73-74
    palliative treatment of, II. 73
    radical treatment of, II. 73
Thyroidectomy for exophthalmic goître, II. 59
Thyroidism, in exophthalmic goître, II. 59
  complicating operation for goitre, II. 69
Thyrotomy in malignant growths of the larynx, III. 854
Tibia, congenital defects of, I. 950
  epiphysis, lower separation of in fracture, I. 632
    upper separation of in fracture, I. 624
  extremity, upper, fracture of, I. 623
  fractures of, I. 622-632
    involving the ankle-joint, I. 628
  internal malleolus of, fracture of, I. 628
  operations on, in congenital club-foot, I. 958
  shaft of, fracture of, I. 624, 625, 626
  spine of, fracture of, I. 624
  torsion or spiral fracture of, I. 657
  tuberosities of, fracture of, I. 623
Tic douloureux, II. 1116
Tics, II. 1047-1049
  convulsive, II. 1047
  of neck, II. 1052
Tilley's tonsil catch forceps, III. 754
Tin, salts of, acute poisoning by, treatment of, I. 529
Tinea cruris, III. 478
  imbricate, III. 480
Tinned foods, poisoning by, I. 510
Tinnitus of the labyrinth, III. 971-973
Tobacco and arterio-sclerosis, I. 1292
  intoxication by, in epilepsy. II. 993
  poisoning by, I. 533
    chronic, I. 534
Tod (Hunter), acute inflammation of the middle ear, III. 894-903
Tod's flap in operation for diseases of mastoid process, III. 925
Toes, amputations of, I. 834-836
  deformed by boots, I. 57
  Farabœuf's method of amputation of, I. 835
  general considerations concerning amputations of, I. 834
Tolu, syrup of, in bronchitis, I. 245
Tongue, acute parenchymatous glossitis in, II. 133
  affections of, II. 132-146
  as an indication of disease, I. 65
  cancer of, I. 124
    ligature of, arteries in, I. 136
  chancre of, II. 134
    drugs in, II. 134
  cysts of, II. 145
  epithelioma of, II. 138-144
    after-treatment of operations for, II. 142
    choice of operation for, II. 139
    invading floor of mouth, II. 143
    operation for, II. 141
    X-rays in, II. 139, 144
  forceps in anæsthetics, III. 2
  geographical (annulus migrans), II. 126-129
  leucomata of, II. 137
  leukoplakia of, II. 137
  nævi of, II. 133
  operations on, and anæsthetics, III. 27
  ranula cyst of, II. 145

- **Tongue** (*contd.*)--
  - sarcoma of, II. 144
  - secondary syphilitic lesions of, II. 135
  - sublingual abscess in, II. 133
  - syphilitic affections of, II. 134-138
    - inveterate chronic glossitis in, II. 136
  - tie, II. 132
    - in newborn child, IV. 358
  - tuberculous disease of, II. 133
  - wounds of, II. 132
- **Tonics** in influenza, I. 236
  - premature use of, I. 64
- **Tonsil**, acute tuberculous ulceration of, III. 757
  - care of in acute rheumatism, I. 271, 276
    - in scarlet fever, I. 284
  - chronic infections of, III. 750-759
    - clinical types, III. 750
    - galvano-cautery in, III. 751
    - general treatment, III. 751
    - morcellement and, III. 751
    - operative treatment, III. 751
    - removal by guillotine, III. 751
    - tubercular ulcer of, III. 757
  - diseases of, III. 747-763
  - embedded in relation to the fauces, III. 750
  - enlarged, in anæmia, II. 14
  - enucleation of, III. 752
  - lingual, benign tumours of, III. 762
    - chronic abscess of, III. 762
    - diseases of, III. 760-763
  - lupus of, III. 757
  - operations of, after-treatment, III. 754
  - pharyngeal, hypertrophy of, III. 732-738
    - anæsthetic in, III. 734
    - instruments in operation for, III. 735
    - operation for, III. 735
  - removal of, and anæsthetics, III. 28
  - retained secretion within, III. 755
  - syphilis of, III. 756
  - tonsilloliths of, III. 755
  - tuberculosis of, III. 757
  - tumours of, III. 758-759
    - benign, III. 758
    - malignant, III. 758
- **Tonsillitis**, acute, III. 747-749
  - general treatment of, III. 748
  - lacunar, III. 747
  - lingual, III. 760
  - local treatment, III. 748
  - parenchymatous, III. 747
  - prophylaxis of, III. 748
  - chronic lingual, III. 761
  - joint affections complicating, I. 391
  - ulcerative, III. 747
- **Tonsilloliths**, III. 755
- **Tonsillotome**, lingual, III. 761
- **Tooth**, adjacent, extraction of, III. 1188
  - brush, daily use of, II. 127
  - fracture of, in extraction, III. 1188
  - hæmorrhage from socket of, I. 1275
- **Tophi** of the auricle, III. 880
- **Torrens (James)**, cœliac disease, II. 426-427
  - embolism (excluding cerebral embolism), I. 1306-1308
  - medical treatment of aortic aneurysm, I. 1297-1300
  - myasthenia gravis, II. 1254
  - pseudo-leukæmia, II. 42
  - treatment of fistulous tracks in empyema by the injection of bismuth and vaseline, I. 1110-1111
- **Torsion-clamp**, method in operation for elephantiasis scroti, III. 509
- **Torticollis**, II. 1050-1053
  - mental, II. 1052
  - neuralgic, II. 1050
  - paralytic, II. 1051
  - professional, II. 1050
  - rhythmic, II. 1052
  - scoliosis and deformities of the shoulders, I. 972-988
  - spasmodic, true, II. 1051
  - wryneck or, I. 987
- **Tourniquet**, control of hæmorrhage, I. 798
  - use of, in hæmorrhage, I. 559
- **Towels**, arrangement of before operation, I. 85
  - sterilisation of, I. 73
- **Toxæmias**, subinvolution of uterus in, IV. 720
- **Toxic** psychoses, II. 1303-1304
- **Trachea**, cancer of, relief of obstruction in, I. 142
  - compression of from without, III. 801
    - diseases of, III. 797
  - fistula of, III. 799
  - gummata of, III. 801
  - inflammation of, in influenza, III. 798
  - injuries of, III. 797
    - in cut throat, II. 165
  - obstruction of, III. 800-802
  - rupture of, III. 797
  - scalds of, III. 797
  - structure of, III. 801
- **Tracheo-laryngostomy** in stenosis of the larynx, III. 866
- **Tracheotomy**, high and low, merits of, I. 197
  - in aortic aneurysm, I. 1299
  - in cancer of larynx, I. 142
  - in diphtheria, I. 195
  - in foreign bodies, III. 820
  - in malignant disease of the thyroid, II. 74
- **Trachoma**, III. 557
- **Transcondyloid** amputation through thigh, I. 862
- **Transfusion** in pernicious anæmia, II. 9
  - in tubal pregnancy, IV. 85
  - of human blood in shock, I. 102
- **Traumatic** cases, amputation in, I. 789
  - cataract, III. 638
  - cyclitis, III. 595
  - gangrene, I. 582

Traumatic (*contd.*)—
neuritis, II. 1106
of the uvula, III. 745
osteomyelitis, I. 889
periostitis, I. 703
pyopneumothorax, I. 1114
rhinitis, III. 704
Traumatism, mineral waters and baths in, III. 145
shock caused by, I. 96
Treatment, based on ætiology, I. 3-9
clinical indications for, I. 20-22
symptomatic, I. 15-20
conservative factors in, I. 11
empirical, I. 1
indications for, I. 2
methods of natural resistance indicating, I. 4
of acute disease, I. 20
of chronic disease, I. 20
of complications and sequelæ, I. 22
of specific causes of disease, I. 4-8
palliative, I. 18
pathological indications for, I. 10-15
practice and management of, I. 22-25
principles of, I. 1-25
rational, I. 1
symptomatic, I. 18
Trendelenburg position, value of, I. 95
Trephining in infective lesions of skull, I. 889
preparation of head for, I. 87
Trichiasis of the eyelids, III. 580
Trichinelliasis, III. 524
prophylaxis of, III. 524
Trichiniasis, III. 524
prophylaxis of, III. 524
Trichinosis, III. 524
prophylaxis of, III. 524
Trichlormethane as anæsthetic, III. 13
Trichocephaliasis, III. 493, 496
Trichorrhexis nodosa, III. 1145
Trigeminal neuralgia, II. 1116
Trigger finger, I. 942
Trigone, exposure and division of, II. 935
Trillat autoclave, fumigation by, I. 163
Trinitin in high blood pressure, I. 1283
Trional, poisoning by, I. 531
Trismus spasm, II. 1048
Trophic diseases, II. 1226
Tropical anæmia, II. 15
diseases, III. 375-516
fevers, undefined, III. 410
liver, II. 676-678
phagedena, III. 472
general treatment of, III. 472
local treatment of, III. 473
prophylaxis of, III. 472
regions, physiological effect of, on Europeans, III. 375
skin diseases, III. 470-486
ulcer, III. 472
Tropics, adaptation of habits to climate in, III. 376
diet in, III. 378
Tropics (*contd.*)--
diseases disseminated by insects in, III. 379
dress in, III. 377
drink in, III. 378
excretal diseases and their dissemination in the tropics, III. 383
food in, III. 378
general hygiene in, III. 375
housing in, III. 379
insecticides in, III. 383
malaria in, III. 380
milk, boiled in, III. 384
personal hygiene in, III. 375
precautions against insanitary conditions in, III. 383
when exposed to sun in, III. 377
protection from insect-borne diseases in, III. 379
rest in, III. 379
ringworm in, III. 478
sleep in, III. 379
sleeping sickness in, III. 383
water boiled in, III. 384
yellow fever in, III. 382
Tropococaine, injection of, for spinal analgesia, III. 37
Trunk exercises in gymnastics, III. 226
-raising exercises for spinal curvatures, III. 238
-rolling exercise in pulmonary disease, III. 252
for scoliosis, III. 242
-rotation exercise in defective metabolism, III. 255
for lordosis, III. 240
varix affecting, I. 1320
Truss, child's double, for inguinal hernia, II. 527
for femoral hernia, II. 526
for inguinal hernia, II. 527
for irreducible hernia, II. 527
for movable kidney, II. 787
in palliative treatment of hernia, II. 498
umbilical, II. 527
Trypanosomiasis, III. 417-422
arsacetin in, III. 421
arsenious acid in, III. 421
arsenophenylglycin in, III. 419
combined therapy of, III. 421
general principles of chemotherapy, III. 419
general treatment of, III. 422
tartar emetic in, III. 421
Trypsin in cancer, I. 151
in treatment of cancer of alimentary system, I. 140
Tubercle bacillus in salpingitis, IV. 815
fistula of anus due to, II. 609
Tubercula dolorosa, I. 112
Tuberculide, papulo-squamous, III. 1152
Tuberculides, III. 1146-1152
Tuberculin, bacillary emulsion, sensitized, III. 294

Tuberculin (*contd.*)—
  Béraneck's, III. 293
  Denys' bouillon filtré, III. 293
  exercise after the administration of, I. 1139
  in pulmonary tuberculosis, I. 1119
  in tuberculous lymphatic glands, I. 1346
    meningitis, I. 249
    peritonitis, II. 646
  Koch's new, III. 293
  Koch's old. III. 293
  Perlsucht, III. 293
  therapy, dosage in, III. 295
    in tuberculosis, I. 323; III. 291-298
    method of administration, III. 294
    of tuberculosis of the kidney, II. 820
    secondary infections in, III. 297
    temperature in, I. 1141
Tuberculosis, acute, I. 332-334
    without localising symptoms, I. 332
  climate for, III. 100
  complicating pregnancy, IV. 50
  diet in, II. 203
  hyperplastic of the colon, II. 590
  miliary or generalised, I. 332
  mineral waters and baths in, III. 143
  of bladder, II. 820
  of breast, II. 981
  of colon, II. 590
  of conjunctiva, III. 560
  of kidney, II. 819-829
  of larynx, III. 870-875
  of nares, III. 687, 688
  of naso-pharynx, III. 742
  of pharynx, III. 793-794
  of tonsil, III. 757
  of uvula, III. 745
  of vulva, IV. 508
  prophylaxis of, I. 1126
  pulmonary, I. 1117-1126
    after-treatment of, I. 1125
    anæmia caused by, II. 13
    anæmia in, I. 1149
    auto-inoculation, regulation of, in, I. 1121
    climate and, IV. 1118
    complications of, I. 1155-1158
      by albuminuria, I. 1157
      by cystitis, I. 1156
      by diabetes, I. 1158
      by empyema, I. 1158
      by epididymitis, I. 1157
      by ischio-rectal abscess, I. 1156
      by pleurisy, I. 1158
      by pregnancy, I. 1155
      by syphilis, I. 1156
    coughs in, various, I. 1144
    creosote vapour bath in, I. 1149
    diet in, I. 1119
    dust and, I. 1118
    dyspnœa in, I. 1138
    exercise in, I. 1123
    fresh air in, I. 1118
    graduated labour in, I. 1159-1163

Tuberculosis, pulmonary (*contd.*)—
    guide to control of auto-inoculation in, I. 1162
    hæmoptysis in, I. 1150
      mild, I. 1150
      moderate, I. 1151
      severe, I. 1154
    increase of patient's resistance to, I. 1118
    induction of an artificial pneumothorax in treatment of, I. 1164-1173
    inhalers, dry, in, I. 1148
    injections, intra-tracheal in, I. 1149
    injections, secondary in, I. 1126
    insomnia in, I. 1149
    Kuhn's mask in, I. 1148
    light treatment in, III. 201
    massage in, I. 1139
    pneumothorax, artificial in, I. 1164-1173
      completion and maintenance of, I. 1168
      complications of, I. 1171
      difficulties of, I. 1167
      duration of, I. 1169
      dyspepsia complicating, I. 1170
      Forlanini's method. I. 1170
      modifications of method. I. 1170
      Murphy's method, I. 1170
      nitrogen apparatus for, I. 1166
      pleurisy complicating, I. 1170
      Saugman's needle for, I. 1167
    pulse rate in, I. 1141
    rest as guide to control of auto-inoculation in, I. 1162
    rest in, I. 1122
    sanatorium treatment of, I. 1127-1158
      daily notes in, I. 1132-1142
      exercise stage in, I. 1129, 1135
      exhaustion in, I. 1138
      lassitude in, I. 1138
      rest stage in, I. 1128
      temperature (body), in, I. 1131, 1135
    secondary infections in, I. 1126
    specific measures for, reputed, I. 1126
    stomach dilatation in, I. 1150
    sweating in, I. 1143
    temperature, effect of the mind on, in, I. 1141
      gastro-intestinal in, I. 1139
      increase in, I. 1140
      post-hæmorrhagic in, I. 1141
    tuberculin treatment of, I. 1119; III. 285-295
      exercise in, I. 1139
      temperature in, I. 1141
    weight, loss of, in, I. 1155
    wind and, I. 1118
Tuberculous abscess, methods of treatment of, I. 173-176
  adenitis, III. 757
  bursitis, II. 1335
  cystitis, II. 861-863

- **Tuberculous** cystitis (*contd.*)—
    - complicating pulmonary tuberculosis, I. 1156
  - disease of the ankle and tarsus, I. 772-775
    - of bones, I. 704
    - of elbow, I. 777-779
    - of Fallopian tubes, IV. 817-819
    - of hip-joint, I. 752-765
    - of jaws, II. 109
    - of joints, I. 750-752
    - of knee-joint, I. 765-772
    - of lymphatic glands, I. 1344-1347
    - of middle ear and its accessory cavities, III. 935-936
    - of ribs, rib cartilages, and sternum, I. 1032
    - of sacro-iliac joint, I. 780
    - of shoulder, I. 775-777
    - of testis, II. 908-909
    - of tongue, II. 133
    - of wrist, I. 779
    - spinal, Pott's disease, I. 922-927
  - empyema, I. 1108
  - epididymitis complicating pulmonary tuberculosis, I. 1157
  - glands, caseating, in the mediastinum, I. 1177
    - surgical treatment of, I. 1348
    - X-rays in, III. 367
  - iritis, III. 589
  - keratitis of the cornea, III. 569
  - meningitis, I. 248, 249
  - onychitis, III. 1082
  - osteitis of the skull, I. 889
  - pericarditis, I. 1184
  - peritonitis, II. 645-647
  - prostatitis, II. 928-929
  - psoriasis, III. 1152
  - pyopneumothorax, I. 1114
  - salpingitis, IV. 817-819
  - sinuses, chronic, I. 176
  - synovitis, I. 752
  - tenosynovitis, II. 1331
  - ulcer, chronic, of tonsil, III. 757
  - ulceration, acute, of tonsil, III. 757
- **Tufnell's** treatment of aortic aneurysm, I. 1297
- **Tumour** cells, embolism by, I. 1306
- **Tumours**, air containing, of the skull, I. 896
  - cerebral, in children, II. 1166
  - gastric, simple, II. 400
  - growing from the bony walls of the cranium, I. 894
  - in connection with tendon sheaths, II. 1331
  - innocent, of the lips, II. 97
    - of the vulva, IV. 511-512
  - intra-abdominal, complicating pregnancy, IV. 55
  - intra-cranial, coma and, II. 983
    - headache from, II. 1034
    - localised, II. 1202, 1203
  - intra-ligamentary, IV. 768-770
- **Tumours** (*contd.*)—
  - malignant, Coley's fluid, III. 298-299
    - degeneration of, I. 119
    - of the lips, II. 97
    - of the prostate, II. 932-938
  - naso-pharyngeal, and Eustachian obstruction, III. 947
  - of bones, I. 708
  - of brain, medical treatment of, II. 1200-1203
    - surgical treatment of, II. 1204-1207
  - of breast, doubtful, operative diagnosis in, II. 979-980
    - operative diagnosis of, II. 979
  - of ovary, complicating labour, IV. 773-774
    - complicating puerperium, IV. 774
    - during pregnancy, IV. 771-772
    - malignant, IV. 786
  - of bile ducts, II. 713-715
  - of bladder, II. 870-873
  - of broad ligaments, IV. 823
  - of gall bladder, II. 710-712
  - of liver, II. 679
  - of nerves, II. 1142
  - of nose, III. 692
  - of orbit, III. 662
  - of prostate, II. 930-949
  - of scalp, I. 892-896
  - of skin, III. 1057
  - of spinal cord, II. 1221-1225
  - of testis, II. 910
  - of uterus, inversion due to, IV. 699
  - of vagina, IV. 553-554
  - of umbilicus due to vitelline remains, II. 278
  - pulmonary, I. 1175
  - simple fibrous, of the vulva, IV. 511
  - solid, of the scalp, I. 892
  - surgical treatment of, I. 106-156
  - vascular, of the scalp, I. 893
    - *See also under* Organs *and* Regions.
- **Tunbridge Wells** spa, III. 156
- **Tunica** vaginalis, diseases and affections of, II. 913-929
- **Turkish** baths in subacute gout contra-indicated, I. 441
- **Turner (G. R.)**, hernia, II. 498-527
- **Turner (Philip)**, fractures, I. 568-633
- **Turner (William Aldren)**, epilepsy, II. 990-1007
- **Turnour (Meadows)**, on return cases of diphtheria, I. 188
- **Turpentine**, Chian, in cancer, I. 148
  - enema, I. 32
  - in constipation in adults, II. 454
  - in phosphorus poisoning, I. 525
  - in typhoid fever, I. 354
  - liniment in whooping cough, I. 379
  - oil of, in hæmophilia, II. 34
  - poisoning by, I. 532
  - stupe, I. 35
- **Tweedy (E. Hastings)**, management of labour in special presentations, IV. 128-156

Tweedy (E. Hastings) (*contd.*)—
management of normal labour, IV. 91-127
Twins, locked, forceps in, IV. 422
podalic version in, IV. 467
presentation of, in labour, IV. 155
Tylosis, III. 1153
Tympanic cavity, mucous membrane of, III. 951
membrane, adhesions of, III. 892
calcareous deposits in, III. 892
congenital absence of, III. 891
perforations of, III. 891
diseases of, III. 891-893
ecchymoses of, III. 891
herpes of, III. 891
inflammation of, III. 891
injuries of, III. 893
malformations of, III. 891
massage of, III. 952
myringitis of, III. 891-892
perforations of, III. 892
in acute inflammation of middle ear, III. 896
rupture of, III. 893
ossicles, massage of, III. 952
Tympanitis complicating typhoid fever, I. 358
Typhoid arthralgia, I. 784
fever, I. 335-364
albumin-water in, I. 342
anti-pyretic treatment of, I. 348
antiseptic treatment of, I. 352
appendicitis and, II. 411
arthritic and bone complications in, I. 363, 784
bacteriology of, I. 345
calomel in, I. 353
cardiac complications in, I. 364
complicating pregnancy, IV. 48
complications and sequelæ of, I. 356-364
cutaneous complications of, I. 356
delirium in, I. 362
diarrhœa in, I. 358
diet in, I. 340 ; II. 202
drugs in, I. 351
epidermiology of, I. 335-337
epistaxis in, I. 357
gastric complications of, I. 357
general remarks on, I. 344
genito-urinary complications in, I. 361
hæmorrhage in, I. 359
hepatic complications in, I. 360
hygiene and management of the patient and household in, I. 338
of mouth and nose in, I. 356
intestinal antiseptics in, I. 353-356
complications in, I. 359
lumbar puncture in, I. 362
meat broths, etc., in, I. 342
middle ear, disease in, III. 902
milk diet in, I. 341
nervous complications in, I. 362

Typhoid fever (*contd.*)—
nursing of, I. 40
origin of outbreaks, I. 336
perchloride of mercury in, I. 353
peritonitis in, I. 359
preventive inoculation of, III. 299
prophylactic inoculation in, I. 348
purgatives in, I. 355
respiratory complications in, I. 361
serum therapy of, I. 347 ; III. 300
thrombosis in, I. 1331
vaccine therapy of, I. 345 ; III. 293, 300
vascular complications in, I. 360
whey in, I. 341
with perforation, II. 550
Woodbridge treatment of, I. 355
Typhus fever, diet in, I. 366
general management of, I. 365
remedial treatment of, I. 366
Tyrnauer's electrical hot-air appliances, III. 320

Ulcers, anæmic, I. 372
callous, I. 370
chronic, I. 369
amputation in, I. 790
dental, in tuberculous disease of the tongue, II. 133
diabetic, I. 373
duodenal, II. 391-394
diet in, II. 211
gastric, II. 375-381
perforation of, II. 389
surgical treatment of, II. 382-388
healing, I. 374
horse serum in, III. 262
in plague, III. 406
inflamed, I. 368
irritable, I. 372
of leg, antiseptic treatment of, I. 83
of the cornea, III. 563
phagedenic, I. 369
perforating, I. 373
complicating diabetes mellitus, I. 426
rodent, III. 1132-1134
ionic medication of, III. 184
of the auricle, III. 879
of the lips, II. 97
of vulva, IV. 508
X-rays in, III. 347
skin grafting in, I. 373-375
sub-lingual in whooping cough, I. 385
syphilitic, mercurial treatment of, II. 135
tropical, III. 472
varicose, I. 372
Ulceration, I. 368-375
complicating cystocele of the vagina, IV. 547
rectocele of the vagina, IV. 547
control of in inoperable cancer, I. 136
of the pharynx, III. 795
treatment of, I. 137

- **Ulna**, congenital defects of, I. 936
  - dislocations of, I. 721
  - shaft of, fracture of, I. 599, 600, 601
  - styloid process of, fracture of, I. 603
- **Ulnar** nerve, dislocation of, II. 1113
  - injuries of, II. 1112
  - neuritis of, at elbow-joint, II. 1112
  - paralysis of, II. 1267
- **Umbilical** belt, child's, II. 527
  - cord, expression of, in podalic version, IV. 466
    - expression of, forceps in, IV. 421
    - failure of, to pull up with uterus in third stage of labour, IV. 120
    - lengthening of, in third stage of labour, IV. 119
    - ligature of, in third stage of labour, IV. 117
    - prolapse of, forceps in, IV. 421
      - labour in, IV. 147
      - podalic version in, IV. 466
    - rupture of, in newborn child, IV. 366
    - secondary hæmorrhage of in newborn child, IV. 370
    - sepsis of, in newborn child, IV. 370
    - shortness of, and accidental hæmorrhage, IV. 29
  - grip in palpation in labour, IV. 99
- **Umbilicus**, acquired affections of, II. 279-281
    - inflammatory conditions of umbilicus as, II. 279
    - urachal cysts as, II. 279
  - acquired fistula of, II. 280
  - affections of, II. 279-281
  - angioma of, in newborn child, IV. 370
  - antiseptic treatment of, I. 91
  - congenital malformations of, II. 227
    - and urinary fistula in infants, II. 278
    - persistence of urachal remains and, II. 278
    - vitelline remains in, II. 277
    - vitello-intestinal fistula and, II. 278
  - inflammation of, II. 279
  - primary epithelioma of, II. 281
  - sarcoma of, II. 281
  - secondary cancer of, II. 281
  - tumours of, II. 280
    - due to vitelline remains, II. 278
  - urinary fistula at, in adults, II. 279
    - in infants, II. 278
- **Uncinariasis**, III. 487
- **Undulant** fever, III. 399
- **Unna's** treatment of ulcers, I. 371
- **Urachus**, cysts of, in acquired affections of the umbilicus, II. 279
  - persistence of remains of, in congenital malformations of the umbilicus, II. 278
- **Uræmia**, II. 837-839
  - headache from, II. 1034
- **Uræmic** coma, II. 982
- **Urea**, solution of, I. 437
- **Ureter**, diseases of, II. 730, 840-851
- **Ureter** (*contd.*)—
  - fistula of, II. 842-845
    - results of uretero-cysto-neostomy in, II. 844
    - treatment, II. 843
  - implantation of in vesical cancer, I. 143
  - malformations of, acquired, II. 774
  - obstruction of, in cancer, relief of, I. 143
  - operations for congenital malformations of, II. 774
  - stone in, II. 846-851
    - instrumental treatment of, II. 847
    - medicinal treatment of, II. 847
    - operative treatment, II. 848
    - results of operative treatment, II. 850
  - wounds of, II. 840
    - results of operative treatment, II. 841
- **Ureteral** catheter in pyonephrosis, II. 815
- **Uretero-cysto-neostomy** in fistula of the ureter, II. 844
- **Uretero-pyelo-neostomy**, II. 776
- **Uretero-vaginal** fistulæ, IV. 534
- **Urethra**, after transverse section of, II. 934
  - caruncle of, dyspareunia in, IV. 841
  - diseases and affections of, II. 882-899
  - female, abscess of, IV. 870
    - carcinoma of, IV. 872
    - caruncle of, IV. 872
    - dilatation of, IV. 869
    - diseases of, IV. 868-874
    - displacements of, IV. 868
    - fibroma of, IV. 872
    - hæmorrhoids of, IV. 872
    - mucous membrane of, prolapse of, IV. 869
    - sacculus of, IV. 870
    - sarcoma of, IV. 872
    - stricture of, IV. 871
    - tender red patches in, IV. 873
  - fistulæ of, II. 894
  - foreign bodies in, II. 884
    - operation for, II. 885
  - hydronephrosis due to obstruction in, II. 772
  - imperforate, of fœtus, complicating labour, IV. 180
  - injuries of, II. 882-885
    - by blow on the perineum, II. 882
    - obstruction due to cancer, relief of, I. 142
  - prostatic, gonorrhœal infection of, I. 227
  - stricture of, II. 886-892
    - acute retention of urine in, II. 890
    - internal urethrotomy in, II. 889
    - uncomplicated, II. 886
- **Urethritis**, chronic (gleet), II. 877-879
  - complicating the puerperium, IV. 329
  - gonorrhœal, complicating the puerperium, IV. 329
- **Urethro-cystitis** complicating gonorrhœa, I. 228

Urethrotomy, external, in acute retention of urine complicating stricture, II. 891
  internal, in stricture, II. 889
Uriage spa, III. 157
Uric acid, diet and, II. 207
  in gout and gouty conditions, I. 436
  solvents of, I. 436
    so called, I. 436
Urinary fistulæ, IV. 535
  organs, cancer of, relief of obstruction in, I. 141, 142
    diseases of, II. 730
Urine, acute retention of, complicating stricture of urethra, II. 890
  alkaline, bicarbonate of soda, producing, I. 423
  production of, I. 410, 418
  Bence Jones protein in, II. 749
  diacetic acid in, in diabetes mellitus, I. 409, 417
  diversion of, in ectopia vesicæ, II. 866
  effect of food on, II. 205
  examination of, in infants, I. 53
    in poisoning, I. 526, 529
  extravasation of, II. 893-894
  in normal puerperium, IV. 258
  incontinence of, I. 53
    care of the skin in, I. 31
    complicating gynæcological surgery, IV. 497
    nocturnal, II. 75-77
  passage of, in normal puerperium, IV. 265
  reflex incontinence of, injuries of the spine, I. 909
  retention of, after operation, management of, I. 29
    complicating abdominal operations, II. 272
      gynæcological surgery, IV. 496
    in acute prostatitis, II. 921
    in injuries of the spine, I. 909
  scanty in scarlet fever, I. 292
  sugar in, in diabetes mellitus, I. 410
  suppression of, in mercurial poisoning, I. 530
    in yellow fever, III. 413
  typhoid bacillus in, I. 346
Urticaria, III. 1154-1156
  complicating pregnancy, IV. 56
  pigmentosa, III. 1154-1156
Uterine forceps with pledget of wool, IV. 625
  souffle in normal labour, IV. 104
Uterus, absence of, IV. 711
  adenomyoma of, IV. 663
  anteflexion of, IV. 670-672
    acquired, IV. 671
    acute, subinvolution in, IV. 722
    congenital, IV. 670
    juvenile, IV. 670
  anteversion of, IV. 669
  application of strong antiseptics to, in puerperal sepsis, IV. 310
Uterus (*contd.*)—
  atony of, after removal of child, in Cæsarean hysterectomy, IV. 399
    retention of placenta in, IV. 229
  bicornal, pregnancy in, IV. 712
  bi-manual compression of post-partum hæmorrhage, IV. 220
  body of, leucorrhœa from, IV. 568
  broad ligaments of, diseases of, IV. 820-823
  cancer of, IV. 575-581
    abdominal total hysterectomy in, IV. 579
    Cæsarean hysterectomy in, IV. 398
    curative treatment, IV. 576
    diagnosis of, IV. 576
    hystero-vaginectomy in, IV. 580
    limits of operations in, IV. 581
    operative treatment, IV. 578
    preventive treatment, IV. 575
    results of operations for, IV. 581
    salpingitis complicating, IV. 814
    vaccine treatment of, I. 133
    vaginal hysterectomy in, IV. 578
  cervical canal of, malposition of, complicating labour, IV. 157
  cervical tear of, secondary closure of, IV. 190
  cervix. *See* Cervix uteri.
  chorio-carcinoma of, IV. 618-619
  chorion epithelioma of, IV. 618-619
  cicatrix of, danger of giving way in Cæsarean section, IV. 396
  condition of in forceps, IV. 424
  contraction of, tonic, complicating labour, IV. 248-249
  control of, in third stage of labour, IV. 118
  curettage of, in puerperal sepsis, IV. 299
  decidua of, and extra-uterine pregnancy, IV. 83
  deciduoma malignum of, IV. 618-619
  degeneration of, Cæsarean hysterectomy in, IV. 398
  development of, imperfect, IV. 711
  diseases of, IV. 575
    dyspareunia in, IV. 841
    mineral waters and baths in, III. 145
  displacements of, IV. 669-699
  double, IV. 543
  douching of, in puerperal sepsis, IV. 310
  empty, and puerperal sepsis. IV. 290
  enlargement of, in acute hydramnios, IV. 44
  evacuation of in puerperal sepsis, IV. 297
  exhaustion of, complicating labour, IV. 250-251
  exploration of, in puerperal sepsis, IV. 295
  fibro-myoma of, Cæsarean hysterectomy in, IV. 398
  fibro-myomata of, Cæsarean section in, IV. 384

Uterus (*contd.*)—
- fibroids of, IV. 634-663
  - complicating extra-uterine pregnancy, IV. 82
  - polypus of, IV. 659
- fistulæ of, IV. 664-668
  - due to injury, IV. 665
  - from malignant growths, IV. 668
- flexions of, IV. 669-699
- fundus of, complete transverse rupture of, complicating labour, IV. 243
  - compression of in post-partum hæmorrhage, IV. 219
  - rising of, in third stage of labour, IV. 120
- hæmorrhage of, accidental, Cæsarean hysterectomy in, IV. 398
- hour-glass contraction of, retained placenta in, IV. 230, 231
- in normal puerperium, IV. 257
- incision of, in Cæsarean section, IV. 388
- inertia of, complicating labour, IV. 252-255
  - drugs in, IV. 253
  - primary, forceps to assist delivery in, IV. 419
- infantile, IV. 711
- infective processes of, fistulæ from, IV. 668
- inflammation of, chronic, Cæsarean hysterectomy in, IV. 398
- injuries of, IV. 575, 707-710
  - by operative procedure, criminal, IV. 708
    - legitimate, IV. 708
  - incidental, IV. 709
- inversion of, chronic, IV. 697-699
  - elastic pressure in, IV. 698
  - puerperal, IV. 697
  - surgical treatment of, IV. 698
  - complete, complicating labour, IV. 184
  - complicating labour, IV. 182-187
  - due to tumours, IV. 699
- involution of, in normal puerperium, IV. 261
- leucorrhœa of, IV. 565
- malformations of, IV. 711-717
- masculinus in hermaphroditism, IV. 865
- mobility of, in third stage of labour, IV. 120
- mucous polypus of, IV. 662
- muscular wall of, overstretching of, subinvolution in, IV. 722
- myoma of, X-rays in, III. 366
- obliquity of, abnormal, forceps in, IV. 420
- panhysterectomy of, IV. 401
- plugging of, in menorrhagia, IV. 757
  - in metrorrhagia, IV. 757
- pregnant, prolapse of, IV. 70
- prolapse of, IV. 688
  - amputation of cervix in, IV. 695
  - anterior colporrhaphy in, IV. 694

Uterus, prolapse of (*contd.*)—
  - posterior colpo-perineorrhaphy in, IV. 694
  - preventive treatment, IV. 688
  - reduction in, IV. 689
  - results of operation, IV. 697
  - retention by pessaries, IV. 690
  - surgical treatment, IV. 692
  - vaginal hysterectomy in, IV. 693
  - vesico-vaginal interposition in, IV. 696
- retroflexion of, IV. 674-688
  - abdominal fixation in, IV. 686
    - operation, IV. 687-688
  - Alexander's operation in, IV. 681, 683
    - difficulties, IV. 683
  - bimanual manipulation in, IV. 676
  - complicating pregnancy, IV. 74-75
  - difficulties in reposition of, IV. 677
  - mechanical treatment by pessaries, IV. 678
  - pessaries in, mode of action of, IV. 680
  - reposition in, IV. 676
    - by the sound, IV. 677
  - sterility in, IV. 856
  - subinvolution in, IV. 722
  - surgical treatment, IV. 681
  - vaginal fixation in, IV. 684
- retroversion of, IV. 672-674
  - douches in, IV. 673
  - massage in, IV. 673
  - reposition by the volsella, IV. 677
  - wool tampons in, IV. 674
- rudimentary, IV. 711
- rupture of, Cæsarean hysterectomy in, IV. 399
  - complicating labour, IV. 238-247
  - curative treatment, IV. 244
  - in puerperal sepsis, IV. 303
  - incomplete, involving perineal coat only, complicating labour, IV. 242
  - limited to lower segment, complicating labour, IV. 240
  - lower wall, complicating labour, IV. 241
  - prophylaxis of, IV. 241
- sarcoma of, IV. 718-719
- septic, Cæsarean hysterectomy in, IV. 399
- shape of, in third stage of labour, IV. 120
- steaming of, in menorrhagia, IV. 760
  - in metrorrhagia, IV. 760
- subinvolution of, IV. 720-724
  - by acute fevers, IV. 720
  - by deficiency of lime salts in the blood, IV. 721
  - by infective processes in pelvis, IV. 723
  - by retention of products of conception, IV. 721
  - by toxæmias, IV. 720
  - due to general causes, IV. 720

Uterus, subinvolution of (*contd.*)—
    local causes, IV. 721
  in Cæsarean section, IV. 391
  tumours of, inversion in, IV. 699
  wall of, growths in, subinvolution by, IV. 722
Uvula, acute inflammation of, III. 745
  benign growths of, III. 746
  deformities of, III. 744
  diseases of, III. 744-746
  elongation of, III. 744
  infections of, III. 745
  malignant diseases of, III. 746
  œdema of, III. 945
  traumatism of, III. 745
  tuberculosis of, III. 745

Vaccination, I. 311-314
  anti-choleraic, III. 423
  diseases ascribed to, I. 313
  in small capillary nævi, III. 1080
  methods of, I. 312
  protective effect of, I. 311
Vaccine in cholera, III. 424
  therapy, control of subsequent doses, III. 267
    doses, summary of, III. 301
    general principles of, III. 258-270, 263
    in acute dysentery, III. 430
    in acute tuberculosis, I. 332
    in cervical endometritis, IV. 630
    in cystitis, II. 860
    in infective endocarditis, I. 206
    in inoperable cancer, I. 133
    in prophylaxis, III. 262
    in purulent meningitis, I. 251
    in staphylococcus infections, III. 282-283
    initial dose in, III. 266
    length of, III. 264
    method of administration of, III. 265
    of acne vulgaris, III. 989
    of acute arthritis, I. 744
      bronchitis, I. 1052
      gonorrhœa, III. 274
    of asthma, I. 1041
    of bacillus coli communis, III. 271
    of boils, III. 1008
    of cancer, I. 152
    of carbuncles, III. 1013
    of cellulitis, I. 182
    of cholera, III. 273
    of chronic bronchitis, I. 1056
      gonorrhœa, III. 275
      rhinitis, III. 709
    of corporeal endometritis, IV. 630
    of dysentery, III. 280
    of gonorrhœa, I. 225 ; III. 274
    of gonorrhœal arthritis, I. 782 ; III. 275
      vulvitis, IV. 527
    of infective pyelonephritis, II. 808
    of influenza, I. 235, 238

Vaccine therapy (*contd.*)—
    of leucorrhœa, IV. 572
    of lupus, III. 1150
    of micrococcus catarrhalis infection, III. 277
    of neonoformans, III. 293
    of pelvic cellulitis, IV. 837
    of peritonitis, II. 637
    of pernicious anæmia, II. 7
    of plague, III. 277
    of pneumonia, I. 263
    of puerperal sepsis, IV. 309
    of pyorrhœa alveolaris, III. 287
    of Rigg's disease, III. 287
    of scarlet fever, I. 288
    of streptococcus infections, III. 289-291
    of tuberculous abscess, I. 176
    of typhoid fever, I. 345 ; III. 300
    of ulcerative colitis, II. 568
    of whooping cough, I. 383
    pneumococcic, in diseases of the pericardium, I. 1184
    results of, III. 269
Vaccines, sensitized, in serum therapy, III. 260
  use of, I. 206, 207
Vacuum, partial for hyperæmic treatment, III. 56
Vagina, absence of lower portion of, IV 543
  atresia of, IV. 541
  cancer of, primary, IV. 553
  congenital malformations of, IV. 541
  cystocele of, complicated by ulceration, IV. 547
    operative treatment, IV. 549
    palliative treatment, IV. 547
  cysts of, IV. 531-532
  discharge from, in sterility, IV. 84 852
  diseases and injuries of, IV. 531-574
  distension of, with lotions in leuco rhœa, IV. 562, 563
  double, IV. 543
  douching of, I. 39
  drainage of, free, in puerperal sepsi IV. 290
  fistulæ of, IV. 533-536
  fixation of, retroflexion of uterus b IV. 684
  foreign bodies in, IV. 537
  hæmorrhage from, in newborn chil IV. 371
  hysterectomy by, in fibroids, IV. 65 658
  in normal puerperium, IV. 257
  incision of, for drainage of pelvis puerperal sepsis, IV. 302
  infections of, IV. 538-539
  inflammations of, gonorrhœal, IV. 56
    in pregnancy, IV. 564
    puerperal, IV. 562
    senile leucorrhœa in, IV. 565
  injuries of, IV. 540

Vagina (*contd.*)—
  inversion of, complicating labour, IV. 182
  laceration of, complicating labour, IV. 201
  leucorrhœa of, IV. 561
  lithotomy by, IV. 877
  lower third, laceration of, complicating labour, IV. 204
  malformations of, IV. 541-544
    acquired, IV. 544
  myomata of, IV. 553
  operations on, preparation of patient in, IV. 484
  ovariotomy by, IV. 795
  plugging of, in accidental hæmorrhage during pregnancy, IV. 24
    in menorrhagia, IV. 757
    in metrorrhagia, IV. 757
  prolapse of, IV. 545-552, 688
    complicating pregnancy, IV. 71
    preventive treatment, IV. 688
  rectocele of, complicated by ulceration, IV. 547
    operative treatment, IV. 551
    palliative treatment, IV. 547
  sarcoma of, primary, IV. 553
  tumours of, IV. 553-554
    leucorrhœa in, IV. 557
Vaginal douches, directions as to, I. 39
  examination, in normal labour, IV. 104
    in pregnancy, IV. 5
  injections in vulvitis, IV. 529
Vaginismus, IV. 860-864
  glass dilators in, IV. 863
  operative treatment of, IV. 863
  palliative treatment of, IV. 862
Valerian in diabetes insipidus, I. 429
Vals spa, III. 157
Valsalva on aortic aneurysm, I. 1297
Valsalva's experiment in patency of Eustachian tube, III. 948
Van Horn's catgut, sterilisation of, I. 72
Vapour, anæsthetic, inhalation of, in labour, IV. 376
  baths, I. 38 ; III. 129
Vapours in asthma, I. 1039
  medicated, in patency of Eustachian tube, III. 951
Varicocele, I. 1323-1327
  diminution in size of, I. 1327
  operation available for, I. 1325
  operative treatment of, I. 1324
  spontaneous disappearance of, I. 1327
Varicose lymphatic glands, III. 516
  ulcers, I. 372
  veins, I. 1309-1322
    complicating pregnancy, IV. 89-90
    hæmatoma in, complicating pregnancy, IV. 90
    hæmorrhage from, I. 1276
    of lower extremities, I. 1311-1319
      hygienic treatment in, I. 1311
      massage in, I. 1312.
      mechanical supports for, I. 1313
Varicose veins of lower extremities (*contd.*)—
      non-operative, I. 1311
      operative treatment of, I. 1315
    of upper extremities, I. 1320
    of vulva, IV. 522
    pain in, complicating pregnancy, IV. 89
    phlebitis in, complicating pregnancy, IV. 89
    recurrence in cases of, after operation, I. 1322
    rupture of, complicating pregnancy, IV. 89
    shrinking of, I. 1321
    spontaneous disappearance of, I. 1321
    thrombosis in, complicating pregnancy, IV. 89
    thrombus in, I. 1331
Varix affecting the trunk, I. 1320
  congenital, I. 1310
Varus at the elbow joint, I. 938
Vasa, division of, in carcinoma of the prostate, II. 936
Vascular degeneration, cerebral thrombosis due to, II. 1177
  disease associated with renal disease, cerebral thrombosis due to, II. 1178
    cerebral thrombosis due to, II. 1177
    syphilitic, cerebral thrombosis due to, II. 1177
Vaseline, injection of, in fistulous tracks in empyema, I. 1110
Vaso-constriction, local, in hæmophilia, II. 33
Vasomotor centres, shock caused by exhaustion of, I. 93
  diseases, II. 1226
  neuroses, II. 1242-1243
    drugs in, II. 1242
Veal, chemical composition of, II. 193
Vegetable food, II. 195
    in gout, I. 452
    poisoning, I. 506
  irritants, poisoning by, I. 533
  preparations for cancer, I. 148
  purgatives, in constipation in adults, II. 447, 454
Vegetables and salads in obesity, I. 472
  chemical composition of, II. 195
  in children's dietary, directions for, I. 59
Vegetarian treatment of obesity, I. 471
Veins, diseases of, I. 1309-1338
  hepatic, obstruction of, II. 667
  methods of infusion into, I. 100
  of the broad ligaments, thrombosis of, IV. 822-823
  pelvic, ligature of in puerperal sepsis, IV. 304
  portal, thrombosis of, II. 666-667
  retinal, thrombosis of, III. 644
  sub-inflammatory conditions of, mineral baths in, III. 138
  varicose, I. 1309-1322

- **Veldt** sore, III. 475
- **Venesection** in aortic aneurysm, I. 1299
  - in chronic congestion of the lungs, I. 1078
  - in diseases of the heart, I. 1211
  - in eclampsia, IV. 36
  - in high blood pressure, I. 1283
  - in intra-cerebral hæmorrhage, II. 1172
- **Venous** hæmorrhage, I. 1271
  - infusion in post-partum hæmorrhage, IV. 222
- **Ventilation** in typhus fever, I. 365
  - of nurseries, methods of, I. 45
  - of sick room, I. 157
- **Ver du Cayor** in myiasis, III. 483
- **Ver macaque** in myiasis, III. 483
- **Veratrine**, poisoning by, I. 533
- **Veratrum** viride in eclampsia, IV. 37
- **Vernet-les-Bains** spa, III. 157
- **Vernon-Harcourt** inhaler for anæsthetics, III. 14
- **Veronal** in diseases of the heart, I. 1225
  - in insomnia, II. 990, 1022
  - poisoning by, I. 531
- **Verrucæ**, warts, III. 1157-1159
- **Verruga** Peruviana, III. 459-460
  - prognosis in, III. 459
- **Version**, anæsthetic in, IV. 463
  - cephalic, bi-polar, IV. 464, 467, 468
    - difficulties in, IV. 465, 469
    - position of mother in, IV. 465
    - steps of operation in, IV. 465
    - time for operating in, IV. 465
      - when head is presenting, IV. 469
      - when shoulder is presenting, IV. 469
    - difficulties of, IV. 464
    - external, IV. 463
    - indications for, IV. 463
    - position of patient in, IV. 463
    - steps of operation for, IV. 463
  - contra-indications in, IV. 462
  - dangers of, IV. 461
  - difficulties of, IV. 461
  - in craniotomy, IV. 411
  - in labour, IV. 461-473
  - indications for, IV. 461
  - methods of, IV. 461
  - podalic, IV. 465
    - accouchement *forcé* in, IV. 466
    - expression of cord in, IV. 466
    - in ante-partum hæmorrhage, IV. 466
    - in cancer of cervix, IV. 468
    - in double monsters, IV. 467
    - in flattened pelvis, IV. 466
    - in locked twins, IV. 467
    - in prolapse of cord, IV. 466
    - indications in, IV. 465
    - internal, IV. 470
      - asphyxia neonatorum in, IV. 473
      - dangers of, IV. 473
      - difficulties of, IV. 472
      - position of mother in, IV. 470
      - position of operator in, IV. 470
      - steps of operation, IV. 470
- **Version**, podalic, internal (*contd.*)—
      - time for operating in, IV. 470
      - when shoulder is presenting, IV. 472
    - mal-presentations of child in, IV. 465
  - position of child in, IV. 462
  - preliminary treatment for all methods in, IV. 462
  - relative advantages of, IV. 432
  - varieties of, IV. 461
- **Vertebræ**, cervical, unilateral luxations of, I. 903
  - fractures of the laminæ of, I. 904
    - of spinous processes of, I. 904
- **Vertebral** hook in craniotomy, IV. 411
- **Vertex**, occipito-posterior positions of forceps in, IV. 430
- **Vertigo**, aural, indications for operation in, III. 974
  - in disseminated sclerosis, II. 1075
  - laryngeal, III. 841
  - of labyrinth, paroxysmal, and middle ear suppuration, III. 960-961
    - of vasomotor origin, III. 958-961
    - with destruction of one labyrinth, III. 961
- **Vesico-cervical** fistula, IV. 880
- **Vesico-urethral** anastomosis, diagram showing plan of, II. 937
- **Vesico-vaginal** fistulæ, IV. 533, 878-881
  - interposition in prolapse of uterus, IV. 696
- **Vesicular** mole, IV. 59
- **Vestibulotomy**, double, in labyrinthitis, III. 962
  - inferior operation of, in labyrinthitis, III. 962-963
- **Vibration** massage, III. 204
  - mechanical, III. 213-221
  - application of, III. 215
    - in abnormal secretion, III. 220
    - in aphonia, III. 219
    - in asthma, III. 216
    - in enlarged glands, III. 218
    - in goitre, III. 216
    - in insomnia, III. 221
    - in neuritis, III. 221
    - in spinal curvature, III. 220
    - to abdominal organs, III. 220
    - to ear, III. 215
    - to eye, III. 215
    - to face, III. 220
    - to the extremities, III. 220
    - to vocal cords, III. 218
- **Vibrator**, Sanitas Electrical Co.'s, III. 214
- **Vibratory** massage in constipation in adults, II. 463
- **Vicarious** action, I. 16
- **Vichy** spa, III. 157
- **Vienna** paste in lupus, III. 1150
- **Vinadis** spa, III. 157
- **Vincent's** angina, III. 771
- **Violet** leaves in cancer, I. 149
- **Viscera**, actinomycosis of, I. 177
  - displacement of, I. 430, 431

- **Viscera** (*contd.*)—
  - neuralgias of, II. 1122
  - perversion of functions of in epilepsy, II. 1018
  - prolapse of, in wounds of abdominal wall, II. 245
  - tæniasis of, III. 521
- **Vitality** of children lowered by "hardening" system, I. 46, 50
- **Vitelline** remains in congenital malformations of the umbilicus, II. 277
- **Vitiligo**, III. 1159
- **Vitreous** opacities in inflammation of ciliary body, III. 593
- **Vittel** spa, III. 157
- **Vocal** cords, application of vibration to, III. 218
  - ataxia of, III. 841
  - internal tensors of, paralysis of, III. 843
  - paralysis of, complete recurrent, III. 844
- **Vœux (H. A. des)**, chicken pox, I. 185
  - influenza, I. 233-242
  - mumps, I. 256-257
- **Voice** production, III. 331-340
- **Voisin's** method of hypnotism, III. 165
- **Volkmann's** contraction, I. 573
    - or ischæmic paralysis, I. 940
  - perforating tuberculosis, I. 889
- **Volsellum**, Fenton's, IV. 476
  - for lacerations of cervix, IV. 190
  - reposition by, in retroflexion of the uterus, IV. 677
- **Volvulus** of the colon, II. 591
  - of the stomach, II. 400
- **Vomit**, examination of, in poisoning, I. 526-535
- **Vomiting**, after ovariotomy, IV. 791
  - and modifications of diet in simple digestive disorders, II. 230
  - anæsthetic, after abdominal operations, II. 263
  - complicating acute endocarditis, I. 1193
    - gynæcological surgery, IV. 489
    - ulcer of the stomach, II. 380
  - drugs in, I. 507, 509, 512
  - following anæsthesia, III. 35
  - in acute gastritis, II. 347
  - in cancer of the stomach, II. 299
  - in disordered digestion in the stomach, II. 373
  - in food fever, II. 234
  - in heart failure, complicating diphtheria, I. 200
  - in pyloric spasm, II. 337
  - in relapsing fevers, I. 267
  - in whooping cough, I. 383
  - irritative, complicating gynæcological surgery, IV. 489
  - mixture for, I. 507, 509
  - neurotic, complicating gynæcological surgery, IV. 489
  - pernicious, complicating, pregnancy, IV. 62-64
- **Vomiting** (*contd.*)—
  - persistent, complicating abdominal operations, II. 269
  - post-anæsthetic, prevention of, I. 84
  - treatment of, in abdominal case, I. 29
- **Vulva**, acuminate, condylomata of, IV. 511
  - atresia, superficial of, IV. 513
  - cancer of, relief of obstruction in, I. 142
  - cleansing of, in normal puerperium, IV. 260
  - clitoris, hypertrophied, and, IV. 514
  - cysts of, IV. 511
  - dermatitis of, IV. 523
  - diphtheria of, IV. 523
  - diseases, affections and injuries of, IV. 505-530
  - eczema of, ointments for, IV. 530
  - effect of irritative discharges to, IV. 506
  - elephantiasis of, III. 515
    - arabum of, IV. 511
  - epithelioma of, IV. 515
  - erysipelas of, IV. 524
  - esthiomène of, IV. 508
  - hæmatoma of, IV. 522
  - hydrocele of the canal of nuck of, IV. 512
  - inflammation of, IV. 523-529
    - appendix of formulæ for, IV. 529
    - dusting powders for, IV. 529
    - gonorrhœal, IV. 524
    - chronic, IV. 561
    - in children, IV. 560
    - in women, IV. 560
    - lotions for, IV. 530
    - mild in women, IV. 560
    - non-venereal, IV. 523
    - vaginal injections in, IV. 529
  - injuries of, IV. 509-510
  - kraurosis of, IV. 508
  - laceration of, complicating labour, IV. 204
  - leucoplakia of, preceding cancer, I. 119
  - leucorrhœa of, IV. 559
  - lipomata of, IV. 511
  - lupus of, IV. 508
  - malformations of, IV. 513-514
  - malignant disease of, IV. 515-516
  - noma of, IV. 508
  - pad in third stage of labour, IV. 125
  - pruritus of, III. 1106-1108; IV. 517-519
    - complicating pregnancy, IV. 72-73
    - drugs in, IV. 517
    - local treatment, IV. 518
  - rodent ulcer of, IV. 508
  - sarcoma of, IV. 516
  - syphilitic affections of, IV. 520-521
    - Ehrlich's "606" in, IV. 521
    - mercury in, IV. 520
  - tuberculosis of, IV. 508
  - tumours of, innocent, IV. 511-512
    - simple fibrous, IV. 511
  - varix of, IV. 522
- **Vulvo-vaginitis** in children, IV. 528, 560

Waggett (E. B.), injuries and malformations of the nasal septum, III. 678-686
Walcher's position for forceps, IV. 424
Walker (J. W. Thomson), affections of the ureter, II. 840-851
  aneurysm of the renal artery, II. 752
  calculus, II. 753-766
  hydronephrosis, II. 770-779
  injury to the kidney without external injury, II. 780-782
  movable kidney, II. 785-791
  perinephritic abscess, II. 801-802
  pyelitis, II. 803-806
  pyelonephritis infective, II. 807-813
  pyonephrosis, II. 814-818
  renal and peri-renal fistulæ, II. 767-769
  surgical treatment of non-suppurative nephritis, II. 798-800
  tuberculosis of the kidney, II. 819-829
  tumours of the kidney in adults, II. 830-835
  tumours of the kidney in children, II. 836
Walker's balance for anæsthetics, III. 14
  pliable ureteral scoop, II. 849
  stone forceps for calculus, II. 760
Walking of infants, risks of too early, I. 51
  on the dorsum exercise for flat foot, III. 235
Wall (Walker), on purin-free food, I. 452
Wallis (Sir F. C.), diseases of the ano-rectal area, II. 593-612
  hæmorrhoids, II. 615-620
  malformations of the anus, II. 613
  malignant growths of the rectum, II. 625
  prolapse and procidenta of the rectum, II. 621-623
  rectal neuroses and obscure rectal pain, II. 614
  simple tumours of the rectum, II. 624
Walls of nursery, covering of, I. 44
Walther (Otto) on pulmonary tuberculosis, I. 1121
Warburg's tincture in malaria, III. 398
Warm climates, diseases of, III. 375-516
Warming for nursery, methods of, I. 44
Warmth necessary during operations, I. 96, 97
  in shock, I. 97
Warts, anatomical, III. 1152
  common, X-rays in, III. 347
  excision of, importance of, I. 118
  gonorrhæal, I. 226
  ionic medication of, III. 184
  of the scalp, I. 892
  post-mortem, III. 1152
  senile, III. 1159
  solid carbon dioxide in, III. 1157
  verrucæ, III. 1157-1159
Washing, disinfection by means of, I. 163
  of infants and children, I. 47
Wassermann reaction in syphilis, I. 325
Water, allowance of in nephritis, II. 206
  as cause of goître, II. 62
Water (*contd.*)—
  boiled, in the tropics, III. 384
  borne typhoid, I. 337
  cold, drinking, in fevers, necessity of, I. 158
    enemas of in typhoid fever, I. 355
  drinking, for young children, reasons for, I. 53
    in gout, I. 434
    in typhoid fever, I. 343
  itch, III. 486
  medicinal use of, III. 111
    nomenclature of, III. 111
  pillows, use of, I. 31
  point of thermal indifference for, III. 113
  sterile, for use at operations, I. 28
Waterbrash in disordered digestion in the stomach, II. 374
Waterhouse (Herbert F.), Bier's treatment by means of induced hyperæmia, III. 40-68
Waters, alkaline, III. 119
    in chronic gastritis, II. 351
  arsenical, III. 122
    in pernicious anæmia, II. 5
    calcareous, III. 120
  chalybeate, III. 122
  diuretic, III. 120
  hypertonic salt, III. 119
  natural aperient, in constipation in adults, II. 466
  radio-activity of, III. 115
  salt muriated, III. 118, 129
  sulphated purgative, III. 121
  sulphur, III. 117
Watson (C. Gordon), surgical diseases of joints, I. 741-788
Watson-Williams (P.), anæmia and hyperæmia of the larynx, III. 822
  hæmorrhage from the larynx, III. 824
  laryngitis, III. 831-837
  neuroses of the larynx, III. 840-845
  œdema of the larynx, III. 858-860
Weaning of infants, II. 218
Wearing apparel. disinfection of, I. 162
Weather, suitable for young children, I. 52
Webbed fingers or syndactyly, I. 943
Wedge, wooden, for separating clenched teeth, III. 1
Weichselbaum's meningococcus, I. 254
Weight and pulley for elbow exercises, I. 778
  (body) influence in osteo-arthritis, I. 400
  extension in sprains, I. 739
    in tuberculous disease of the knee-joint, I. 767
    in tuberculous joints, I. 764
      synovitis, I. 752
  loss of, in cancer of alimentary system, I. 139
    in pulmonary tuberculosis, I. 1155
Weilbach spa, III. 157
Weir-Mitchell treatment in coccygodynia, I. 921

Weir-Mitchell (*contd.*)—
  in hysterical joint disease, I. 788
  of neurasthenia, II. 1040
Weisbaden spa, III. 157
Welch and Schamberg on treatment of small-pox eruption, I. 306
Wells (A. Primrose), mechanical vibration, III. 213-221
  treatment by various forms of light, III. 186-202
Wells (Russell) on cocaine in whooping cough, I. 381
Wertheim's operation, complications of, IV. 605
  dangers of, IV. 605
  difficulties of, IV. 605
  dividing para-vaginal tissue in, IV. 606
    vagina in, IV. 607
  hæmorrhage in, IV. 607
  identifying the ureter in, IV. 603
  immediate results of, IV. 608
  in cancer of cervix, IV. 601
  isolating the ureter in, IV. 605, 606
  ligature of uterine artery in, IV. 604
  limits of, IV. 610
  percentage of, IV. 609
  removing iliac glands in, IV. 608
  shock in, IV. 607
  standpoint of pathology of, IV. 601
  technique of operation, IV. 602
  ultimate results of, IV. 609
West (C. Ernest), acute diseases and suppuration of the labyrinth, III. 958-966
West Africa, malaria and, III. 381
Westmacott (F. H.), diseases and affections of the accessory sinuses of the nose, III. 716-731
Wet-nursing, II. 219
Wet-pack, use of, in typhoid fever, I. 350
Wethered (Frank J.), atelectasis and collapse of the lungs, I. 1063-1065
  emphysema and its varieties, I. 1082-1089
Wetterstrand's method of hypnotism, III. 164
Whey in infant feeding, II. 227
  in marasmus, I. 465
  in typhoid fever, I. 341
Whistler's laryngeal forceps, III. 848
White (W. Hale), colitis, II. 562-569
  empyæma, I. 1099-1100
  exophthalmic goitre, II. 54-57
  pneumonia, I. 258-263
Whitehead (A. L.), intra-cranial and intravenous complications of ear disease, III. 937-943
White-leg in puerperal sepsis, IV. 321
Whitlow (Sir W.), on food and diet, I. 341
Whitlow, cause and treatment of, I. 168-170
  sub-cutaneous, I. 169
  sub-cuticular, I. 169
  sub-periosteal, I. 169
  thecal, I. 169
Whooping-cough, I. 376-385
Whooping-cough (*contd.*)—
  associated with measles, I. 243
  diet in, I. 379
  external applications to chest in, I. 379
  general treatment of, I. 377
  incubation period of, I. 377
  local applications in, I. 379
  medicinal treatment of, I. 380
  prevention of, I. 376
  treatment during convalescence, I. 384
    of paroxysm, I. 379
  vaccine therapy of, I. 383
Widal's test in typhoid, I. 337, 347
Wildbad spa, III. 157
Wilde's incision in acute inflammation of middle ear, III. 897
Wildungen spa, III. 157
Wilkinson (G.), foreign bodies, maggots and rhinoliths, III. 667-669
  influenzal tracheitis, III. 798
  injuries of the trachea, III. 797
  tracheal fistulæ, III. 799
    obstruction, III. 800-802
Willcox (W. H.), asthma, I. 1035-1042
  food poisoning, I. 506-511
  poisons and antidotes, I. 526-535
Williams (Leonard), administration of thyroid extract, II. 49-50
  blood pressure, I. 1281-1286
  congestion and inflammation of the thyroid gland, II. 51-52
  infantilism, II. 71
  myxœdema and cretinism, II. 72
  nocturnal enuresis, II. 75-77
  obesity, I. 468-474
  thyroid inadequacy, II. 78
Williams (Whitridge), on pubiotomy, IV. 449
Wilson (S. A. Kinnier), amyotrophic lateral sclerosis, II. 1054
  bulbar palsy, II. 1061
  facial hemiatrophy, II. 1232
  herpes zoster, II. 1096-1097
  hydrocephalus, II. 1191-1192
  intermittent claudication, II. 1234-1236
  Landry's paralysis, II. 1080
  paramyoclonus multiplex, II. 1255-1256
  paraplegia, II. 1195-1199
  progressive muscular atrophy, II. 1081-1082
  torticollis, II. 1050-1053
  vasomotor neuroses, II. 1242-1243
Wilson (Thomas), flexions and displacements of the uterus, IV. 669-699
Wind and pulmonary tuberculosis, I. 1118
  cold, protection of young children from, I. 52
Windows, arrangement of, in nurseries, I. 45
Wine, avoidance of in gout, I. 448
  egg, preparation of, I. 43
  in gouty conditions, I. 457
  iron, in chlorosis, II. 25
Witch hazel in hæmorrhage, I. 1261
Withering on digitalis, I. 1218

Witzel's method for malignant stricture of the œsophagus, II. 182
Woillez, maladie de, I. 1076
Wolff's law in deformities, I. 934
Woodbridge treatment of typhoid fever, I. 355
Woodhall spa, III. 157
Woods (John F.), hypnotism and treatment by suggestion, III. 159-179
Woods' method of hypnotism, III. 166
Wool for surgical dressings, I. 74-78
Woollen clothing for rheumatism, I. 485
  underclothing for children, I. 50
Wool-sorters' disease, I. 179
Word-deafness, restoration in by functional compensation, II. 1146-1149
Workmen's Compensation Act and electric shock, I. 548
Worth's amblyoscope in strabismus, III. 652
Wounds, I. 550-556
  antiseptic treatment of, I. 85
  bursting of, complicating gynæcological surgery, IV. 496
  cellulitis following, I. 181
  cleansing of, I. 550
  closure of, I. 551
  complication of, I. 555
  concentrated arc light in, III. 200
  drainage of, I. 551
  dressings in, I. 554
  examination of, I. 550
  gangrene from, I. 214
  general, I. 540-544
    treatment of, I. 555
  granulation in, I. 554
  gunshot, I. 557-567
    abdominal injuries in, I. 565
    amputation in, I. 562
    cardiac injuries in, I. 565
    cranial fractures in, I. 562
    facial injuries in, I. 563
    fractures in, I. 561
    hæmorrhage in, I. 559
    injuries of nerves in, I. 560
    joint injuries in, I. 562
    lodged missiles in, I. 558
    neck injuries in, I. 564
    of liver, II. 251
    of the abdomen, II. 248
    of the eyeball, III. 657
    of the skull, I. 877
    of the spine, I. 902
    of the stomach, II. 283
    penetrating of chest, I. 564
    prevention of infection in, I. 557
    septic, I. 558
    shock in, I. 558
    spinal injuries in, I. 563
    traumatic aneurysms in, I. 560
  implantation cysts, due to, I. 111
  in tetanus, local treatment of, I. 329
  incised, of abdominal wall, II. 249
  injuries of, with external wound, II. 783-784
Wounds (*contd.*)—
  local treatment of, I. 550
  nerve injury in, II. 1099
  non-penetrating, of abdominal wall, II. 246
  of brachial plexus, II. 1110
  of diaphragm, II. 253
  of facial nerve, II. 1108
  of iris, III. 591
  of lips, II. 96
  of muscles, II. 1321
  of nerves, II. 1098-1105
  of special blood-vessels, I. 1274
  of special nerves, II. 1108-1113
  of tongue, II. 132
  of uterus, IV. 575
  subcutaneous, to nerves, II. 1100
  sutures in, I. 553
    in amputations, I. 802
  vicious contraction in, I. 555
Wright (Sir Almroth), on pulmonary tuberculosis, I. 1121
  on vaccine treatment of cancer, I. 152
Wright's extension in tuberculous disease of the hip-joint, I. 754
  salt and citron lotion, I. 168, 176
Wringer for fomentations, I. 35
Wrist, congenital contraction of, I. 937
    dislocation of, I. 723, 937
  dropped, in paralytic deformities of the upper limb, I. 990
    paralytic, prognosis in, I. 992
  paralysis of, in lead poisoning, I. 513
  spontaneous subluxation of, I. 939
  tuberculous disease of, I. 779-780
    operative treatment, I. 780
Wrist-joint, disarticulation at, I. 813-816
  by circular incision, I. 815
  by elliptical incision, I. 813
  fracture in the neighbourhood of, I. 602-603
Writer's cramp, II. 1264
  hypnotism in case of, III. 174, 175
  Nussbaum's bracelet in, II. 1265
Wryneck or torticollis, I. 987
  physical exercise for, III. 233
  spasmodic, physical exercises in, III. 257
Wyatt (James), abnormalities of the maternal soft parts affecting labour, IV. 157-160
  deformities and diseases of the fœtus causing obstruction to labour, IV. 176-181

Xanthelasma of the eyelids, III. 582
Xanthoma, III. 1160
  diabeticorum, III. 1160
Xeroderma, III. 1053
  pigmentosum, III. 1057
Xerosis of the conjunctiva, III. 561
Xerostomia (dry mouth), II. 130
  in inflammation of parotid glands, II. 163

X-rays, application of, for ringworm, head in position during, III. 356
  in leukæmia, II. 39
  position of nails during, III. 351
box shield, with lead-glass localiser, III. 342
dermatitis, preceding cancer, I. 117; III. 1030
examination in calculus of the bladder, II. 853
for comedones, III. 1023
in acne rosacea, III. 350
in acne vulgaris, III. 349, 987
in cancer, I. 154
in chronic affections of the nails, III. 351
  eczema, III. 351
  lichen planus, III. 351
  localised inflammations, III. 349
in common warts, III. 347
in disease, cardinal points in, III. 362
in disseminated sclerosis, II. 1074
in elephantiasis, III. 353
in epithelioma of tongue, II. 139, 144, III. 348
in Hodgkin's disease, I. 1342
in hyperidrosis, III. 359
in hypertrichosis, III. 1046
in kerion, III. 1129
in lichenification, III. 1060
in lupus, crusted and ulcerated, III. 353
  verrucosus, III. 352
  vulgaris, III. 352, 353, 1148
in malignant disease, III. 362
in mycosis fungoides, III. 1076
in pruritus, III. 359
in psoriasis, III. 351, 1122
in pyonephrosis, II. 814
in ringworm, III. 354, 1125
in rodent ulcer, I. 115; III. 347, 1133
in scrofuloderma, III. 352
in seborrhœa, III. 359
in skin diseases, earlier methods of, III. 341
  present methods, III. 342
  protection of patient in, III. 345
in spleno-medullary leukæmia, III. 363
in sycosis, III. 350
in syringomyelia, II. 1219
in treatment of cancer, I. 129
  of skin diseases, III. 340-359

X-rays (*contd.*)—
in tuberculosis of the skin, III. 353
in tuberculous disease of lymphatic glands, I. 1344
modification of skin functions by, III. 353
treatment of diseases other than skin diseases, III. 360-368
use of, protection of the operator during, III. 343

Yaws (Frambœsia tropica), III. 461
Yeast in acne vulgaris, III. 988
  in boils, III. 1008
  in leucorrhœa, IV. 572
  in rabies, III. 288
  powder in leucorrhœa, IV. 572
Yellow fever in the tropics, III. 382
  prophylaxis of, III. 412
  symptomatic treatment of, III. 412
Yew, poisoning by, I. 533
Young (**R. A.**), congestion and œdema of the lungs, I. 1076-1081
Yverdon spa, III. 158

Zambelleti's subcutaneous injections of iron and arsenic, II. 294
Zander Institutes, use of, in obesity, I. 470
Zander treatment, III. 369-374
  in disorders of the circulation, III. 371
  in disorders of the digestive system, III. 372
  in functional derangements of joints, III. 373
  in scoliosis, III. 372
  of fractures, III. 374
Zeroni's hook, III. 915
Ziegler's sickle knife, III. 637
Zinc astringent solutions in gonorrhœa, I. 224
  dressings in burns and scalds, I. 541
  percentage of in cyanide gauze, I. 76
  salts of, acute poisoning by, I. 529
    in epilepsy, II. 998
Zittmann treatment of syphilis, I. 323
Zyzygium jambulanum in diabetes mellitus, I. 424

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